Sky and TELESCOPE

In This Issue:

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Vol. XXII, No. 4

OCTOBER, 1961

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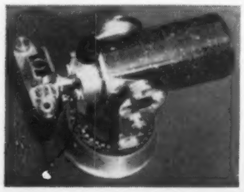
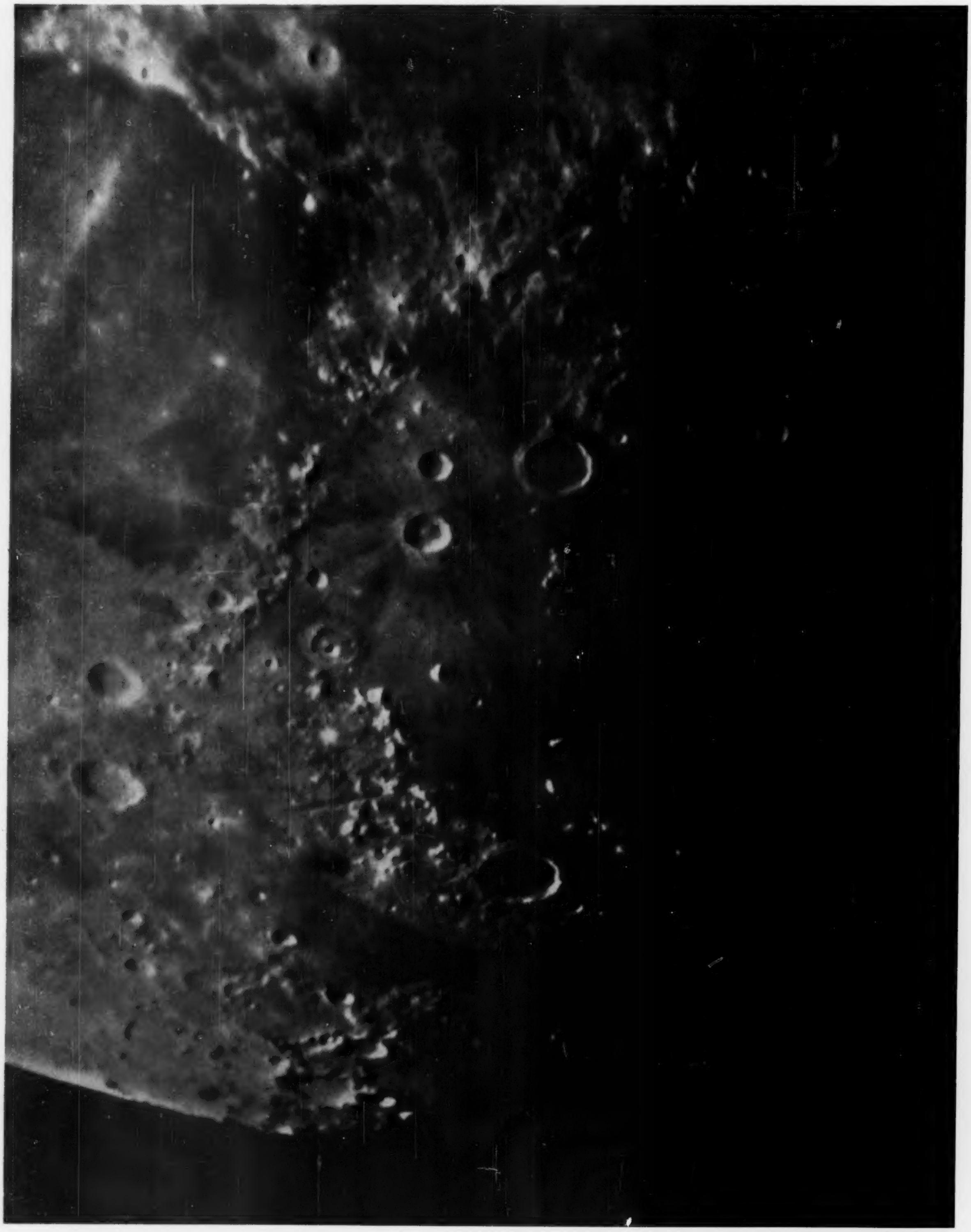
Sundial on the equator





Sky and TELESCOPE

CHARLES A. FEDERER, JR., *Editor*
JOSEPH ASHBROOK, *Technical Editor*

Vol. XXII, No. 4 — OCTOBER, 1961

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COVER: Prof. Luciano Andrade Marin examines a sundial in the garden of his solar museum near Quito, Ecuador. Located exactly on the equator, the sundial needs two faces, since for half the year the sun is to the north, and the other half it is to the south. Photograph by Julio Garzon. (See page 192.)

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An Exciting August

THIS MAGAZINE is hard pressed to cover the news in these days of major advances in all fields of astronomy and rapid expansion of both professional and amateur societies. Sometimes, as in August, everything seems to happen at once.

As if heralding all the coming activities, Comet Wilson appeared late in July, and in early August many amateurs observed and photographed it, while professionals were busy recording its spectrum and changes in appearance.

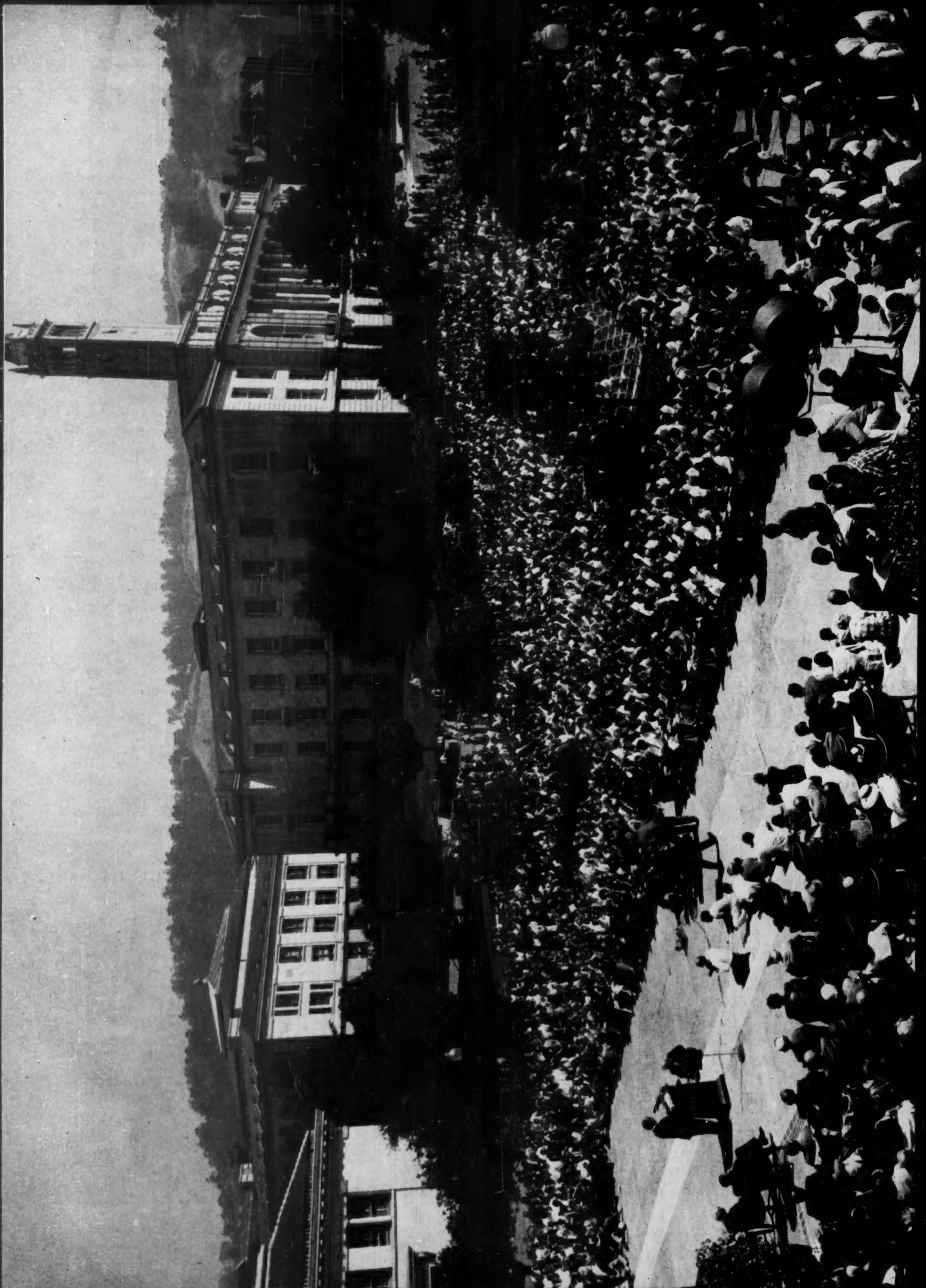
This year's Perseid meteor shower was one of the best in a long time, and a multitude of detailed, carefully made reports have been received. These can only be briefly treated on the Observer's Page, where space also is required for August's auroral reports and for notes on Jupiter's red spot, which is now prominent.

Climaxing this month's observing program was the lunar eclipse of August 25th, for which weather conditions were fairly good. Within a week our folder of stories and pictures had become four inches thick. Some readers would, no doubt, enjoy every one of these accounts of amateur activity, and if space permitted all good pictures would be published. Our abbreviated version begins on page 200, with a few photographs.

August is always the month of the Stellafane get-together of eastern telescope makers. Last year a hurricane deluged the proceedings, but this year's program was complete, as told by Boston amateur James W. Gagan on page 208. And on the West Coast, late in the month, the Western Amateur Astronomers had a very fine gathering, reported by the well-known comet photographer, Alan McClure, on page 194. The eclipse of the moon was a feature of this meeting.

Finally, there was the 10-day 11th General Assembly of the International Astronomical Union, at Berkeley, California, in the middle of the month. Among nearly 1,000 delegates and registered guests were six SKY AND TELESCOPE staff members, who were unable to cover all the commission meetings, special sessions, invited discourses, field trips, and informal gatherings, simply because of the multiplicity of these events. The IAU then had 58 commissions and subcommissions, their sessions in some cases lasting several days and uncovering many new scientific advances.

While there we edited and published an *IAU News Bulletin* of about 12 pages on each of eight days, carrying both program announcements and news of the sessions and field trips. Some of the bulletin's illustrations will appear in SKY AND TELESCOPE as occasion permits, as in our first Berkeley report, which begins on page 185 of this issue.



IAU Berkeley Assembly

Jan H. Oort, director of Leiden Observatory and retiring president of the International Astronomical Union, welcomes the delegates at the opening ceremonies. Behind him sit Ambassador Stevenson (center) and Leo Goldberg of Harvard Observatory, who introduced the morning's speakers.

IN JUNE of this year, each member of the International Astronomical Union received by mail a 600-page book from the organization's general secretary, D. H. Sadler of the Royal Greenwich Observatory. This volume was the agenda for the 11th General Assembly. Crammed with long reports on scores of branches of astronomy, with texts of proposed resolutions, organizational matters, and financial accountings, it gave a preview of the vastness of the gathering two months later when nearly a thousand astronomers from all parts of the world convened at the University of California in Berkeley.

The agenda volume states clearly and simply the purpose of the union: to facilitate relations between astronomers of different countries when organized international co-operation is useful or necessary, and to promote the study and development of astronomy in all its divisions.

At the General Assembly, held every three years, voting is by adhering nations, each having one vote. This is the IAU's legislative body. In the commissions, however, the voting is by individual members, who are astronomers selected as specialists. The more than 30 commissions are the actual working groups that carry out the aims of the union; they are formed "for the study of special branches of astronomy, the encouragement of collective investigations, and for the discussion of questions relating to international agreements or to standardization."

For instance, the agenda included the text of a resolution concerning variation of latitude, referred to the IAU by the International Union of Geodesy and Geophysics. It stated that both astronomers and geophysicists have more need than ever before for precise data on the motion of the earth's poles, regularly supplied by the International Latitude Service. It recommended that the ILS be reorganized into an International Polar Motion Service, utilizing time and latitude observations made at both the present ILS stations and at other observatories.

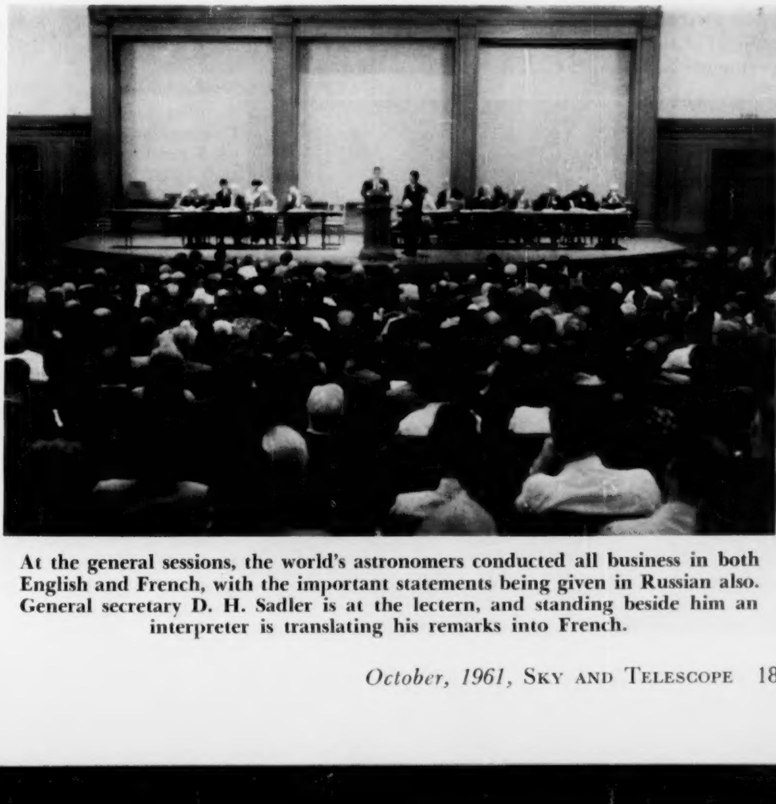
This resolution made specific recommendations, for example, that a new Danjon-type astrolabe be installed in the ILS station at Mizusawa, Japan; that the observatory of Quito, Ecuador, place in service the astrolabe that has been sent there; and that two other instruments of this kind be set up in the Southern Hemisphere. Already, the national observatory of Chile plans to install one near Santiago.

A resolution such as this will often overlap the interests of many commissions. Thus the Danjon astrolabe was discussed at length by Commission 8 (Positional Astronomy); this refined new device is at work at Paris, Greenwich, and other observatories, for observing accurate places of fundamental stars.

The astronomers' gathering at Berkeley attracted wide attention, locally and nationally. At the August 15th opening ceremonies, pictured opposite, a message was read from President John F. Kennedy, who said in part,

"Astronomy is an ancient art, and from the earliest times has known no national boundaries. Today, American astronomers work with their colleagues in observatories all over the world. I hope that tomorrow this collaboration will extend to observatories in outer space. The breadth and freedom of scientific exchange among astronomers sets a high example for other disciplines. I know that this exchange will continue, even as man's curiosity

FACING PICTURE: A view of Dwinelle Plaza on the Berkeley campus of the University of California, the morning of August 15th. On the rostrum (left) is Ambassador Adlai E. Stevenson, the chief speaker at the opening ceremonies of the 11th General Assembly of the International Astronomical Union. Nearly 10,000 persons attended. The campanile, a university landmark, is at upper right beyond Wheeler Hall, the large building where the assembly's general sessions were held. To its left is the university library, and at far left a corner of Dwinelle Hall, in which most of the commission meetings took place. Photographs with this article are by the staff of this magazine, and originally appeared in the "IAU News Bulletin."



At the general sessions, the world's astronomers conducted all business in both English and French, with the important statements being given in Russian also. General secretary D. H. Sadler is at the lectern, and standing beside him an interpreter is translating his remarks into French.

Japanese delegates to the Berkeley assembly are (left to right) K. Kawabata, K. Takakubo, Y. Hagihara, S. Obi, and S. Nagasawa; visitors from Europe included L. Rosino (Asiago, Italy), Miss L. M. Volders (Leiden, the Netherlands), and M. G. Fracastoro (Catania, Italy). These pictures were taken in Dwinelle Plaza during one of the morning coffee breaks.

about the structure and history of the universe continues."

From the United Nations came U. S. Ambassador Adlai E. Stevenson, who described the impact of scientific advances on society. He pointed out that only after a new scientific product is fully built and functioning do men outside of science begin to think of its human and political implications. "We are forever running today to catch up tomorrow with what science made necessary yesterday."

He said further, "In just a few years there will be rocket boosters, in more than one country, big enough to launch whole teams of men on journeys to the nearest planets. Shall this too, at huge and wasteful expense, be a race for military or psychological advantage? Or shall it be the occasion for teamwork, ignoring ideological lines? We haven't much time left in which to decide – it is a fork in the road which soon must be passed."

There were two general sessions of the assembly, both held in the large auditorium of Wheeler Hall, one the afternoon of the opening day. The second was on the final day, the 24th. Jan H. Oort, president of the union, was in charge, and interpreters summarized each stage of the proceedings in French, English, and Russian. A revised set of statutes and by-laws was formally adopted.

One important problem had arisen concerning the admission of Taiwan to the IAU by action of the executive committee on September 8, 1959. As a result of this, the People's Republic of China had resigned from the union, and the Czechoslovak and U. S. S. R. national committees of astronomy had filed resolutions that Taiwan's admission be revoked. The vote at the first general session was 24 to five against the resolutions, with four nations abstaining. The status of Taiwan thus remained unchanged, but a telegram was sent to the astronomers of the People's Republic of China regretting their absence from the meeting and encouraging their work.

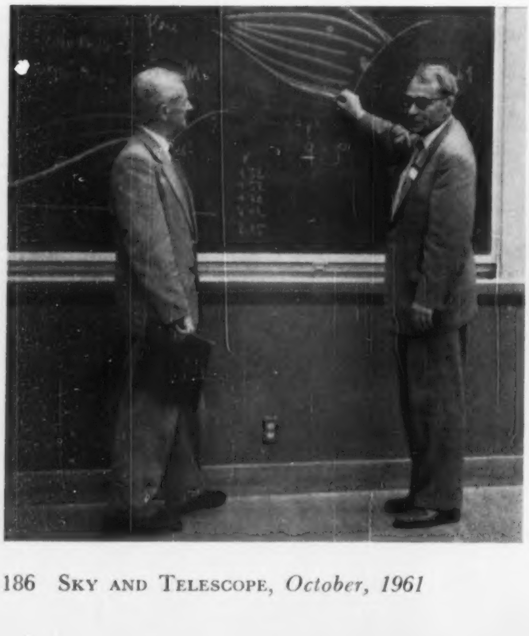
On August 16th, the commissions began their individual meetings, that morning's schedule listing Commission 4, Ephemerides; 8, Positional Astronomy; 9, Instruments; 9a, Image Converters; 12, Solar Radiation; 14, Wave-Length Standards; 22, Meteors and Meteorites; 24, Stellar Parallaxes; 27, Variable Stars; 28, Extragalactic Nebulae; and 34, Interstellar Matter.

That afternoon the following met: 5, Bibliography; 7, Celestial Mechanics; 10, Solar Activity; 14a, Intensity Tables; 15, Physical Study of Comets; 33, Galactic Structure; and 42, Photometric Double Stars.

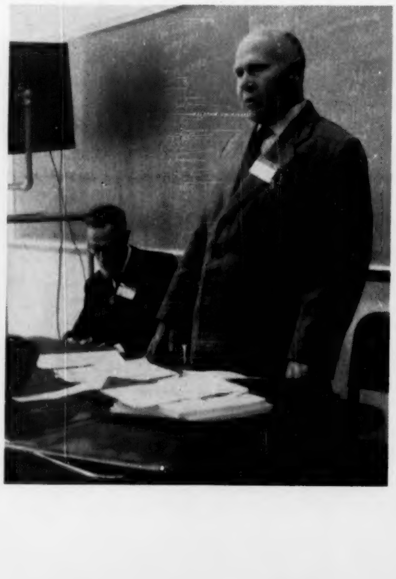
This day's program typifies the wide range of subjects that make up astronomy today, yet these 18 are less than a third of the total number of IAU commissions and subcommissions, nearly all of which held sessions at Berkeley.

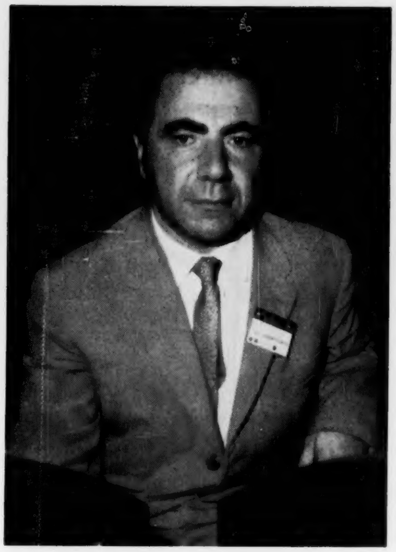
On Thursday the 24th, the delegates gathered again for the final session. They heard a report of the finance committee by its chairman, Charles Fehrenbach of Marseilles Observatory. The budget for the next three years of operation is nearly \$132,000, of which about a third is scheduled to carry out or support important projects and programs. For a bibliography of astronomy from 1881 to 1898, \$5,000 is set aside, while the IAU Telegram Bureau in Copenhagen requires only \$2,000 for three years. An annual grant of \$750 is made to the Minor Planet Center at Cincinnati Observatory, and the Carte du Ciel program receives nearly \$9,000 over-all.

Half of the project allocation, or \$7,500 annually, goes to Commission 38 for its exchange-of-astronomers program. The



Commission meetings occupied most of the time of the 10-day program. At the left, M. Waldmeier of Switzerland uses the blackboard to illustrate phenomena in the sun's atmosphere to Sydney Chapman of Great Britain. To study solar-terrestrial relationships, the IAU has established an inter-union commission, in collaboration with other international scientific bodies. At the right, D. Y. Martynov, director of Moscow's Sternberg Institute, presides over a meeting of Commission 5 (Bibliography). Seated beside him is A. Dermul of Belgium, the commission's secretary.





The new president of the union, V. A. Ambartsumian, is director of the Armenian Academy of Sciences.

acting president, M. G. J. Minnaert, noted that since 1946 a total of 99 working visits of astronomers to other countries had been arranged, the pace regularly increasing. In 1952-54, 14 astronomers made exchange journeys, 22 during the next three years, and 30 from 1957 to 1960.

In this latest period, Czechoslovak astronomers went to England, France, Mexico, and the United States; a Spaniard visited Cambridge Observatory, while a British astronomer went to Madrid and Tenerife. Italian students worked in England, California, and the Netherlands, while Italy was visited by astronomers from Greece, France, and Belgium. Indian astronomers have come to four American observatories, to Sweden, and to Scotland, while Japanese have visited Canada, Holland, and England. Other travelers in the list are Finnish, Ecuadorian, and American.

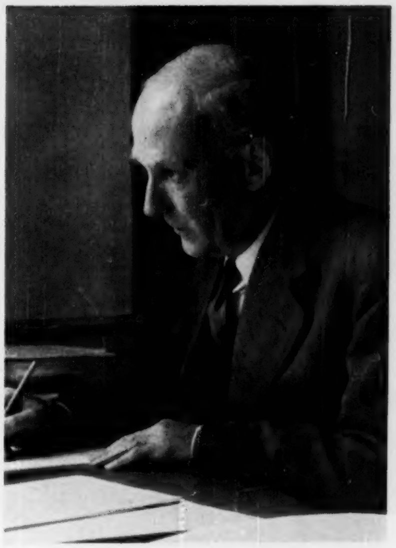
Appended to Commission 38's draft report is a comprehensive list of observatories in 15 countries that have opportunities for visits from foreign astronomers. It is significant that the IAU budget granted this commission $1,500 more annually than was requested in the draft report.

Attendance at the IAU General Assembly itself is financially difficult for many foreign astronomers. Commission 38 granted $1,000 to assist young scientists attending the Moscow meeting in 1958, but the problem was a greater one this year, Berkeley being remote from European observatories. For this reason, the U. S. national committee of the IAU set up a special finance committee, under the chairmanship of Donald H. Menzel, director of Harvard Observatory.

Funds were solicited from government, educational, and commercial institutions, for both the operation of the Berkeley assembly and IAU symposia and for assisting foreign astronomers in traveling to these events. The project was very successful, over $260,000 being obtained from 83 donors, whose names were listed in the official program and the *IAU News Bulletin.* An additional aid to travel was the practice by several American observatories and laboratories of inviting astronomers from other countries to pay scientific visits at times convenient for their attendance at Berkeley.

Three countries have become new members of the IAU – Brazil, Turkey, and North Korea. V. A. Ambartsumian, of Burakan Observatory, U. S. S. R., was elected president to succeed Dr. Oort for the next three years. Y. Hagihara, Tokyo University, Japan, and G. Haro, Tonantzintla Observatory, Mexico, are new vice-presidents.

The General Assembly approved and supported the recommendations adopted by individual commissions during the preceding week, and then considered the following pair of resolutions concerning problems of deep current importance. The second deals specifically with Project West Ford (SKY AND TELESCOPE, July, 1961, page 25). Both resolutions were adopted unanimously.



Jan H. Oort, one of the world's most versatile astronomical researchers, had served as president since the 1958 Moscow assembly of the IAU.

Resolution No. 1

Viewing with great concern the grave danger that some future space projects might seriously interfere with astronomical observations in the optical as well as in the radio domain,

and *believing* that a degree of contamination of space which at the present time would be hardly detectable, might, if long-lived, well be disastrous to future observations with improved techniques,

and *maintaining* that no group has the right to change the Earth's environment in any significant way without full international study and agreement;

the International Astronomical Union

D. H. Sadler (right), of the Royal Greenwich Observatory, as the IAU's general secretary was largely responsible for the smooth running of the assembly's complex scientific program. He was ably helped by Miss Nel Splinter (left), the assistant secretary of the IAU.

Five of the IAU's six vice-presidents are pictured on this page (G. Haro, Tonantzintla Observatory, Mexico, was not at Berkeley). At the left in this row is R. M. Petrie of Dominion Astrophysical Observatory, Canadian specialist in stellar spectroscopy. Y. Hagihara, Tokyo University, is an expert in celestial mechanics; and B. Sternberk, director of the Astronomical Institute at Prague, Czechoslovakia, is an authority on precise timekeeping.

gives clear warning of the grave moral and material consequences which could stem from a disregard of the future of astronomical progress,

and *appeals* to all Governments concerned with launching space experiments which could possibly affect astronomical research to consult with the International Astronomical Union before undertaking such experiments and to refrain from launching until it is established beyond doubt that no damage will be done to astronomical research.

Resolution No. 2

The International Astronomical Union expresses its appreciation that the plans for Project West Ford have been publicly announced well ahead of proposed launching and of the United States Government's official policy* that further launchings will be guided by the principle that such projects shall not be undertaken unless sufficient safeguards have been obtained against harmful interference with astronomical observations.

Nevertheless the International Astronomical Union views with the utmost concern the possibility that the band of dipoles proposed in Project West Ford might be long-lived, and it is completely opposed to the experiment until the question of permanence is clearly settled in published scientific papers with adequate time being allowed for their study. The International Astronomical Union is opposed to any experiment which might hamper future developments in astronomy.

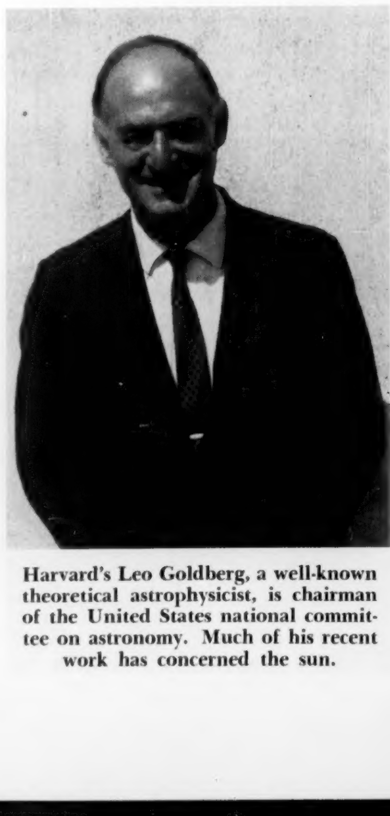
If a short lifetime for the dipoles and the harmless nature of the experiment can be assured, and if Project West Ford is carried out, the International Astronomical Union regards it as essential that the fullest observations of, and experiments on, the properties and behavior of the band of dipoles be carried out by all possible means. The observations and experiments should be performed and analyzed according to the highest scientific standards and with the best equipment available, bearing in mind that signals which are barely detectable today will probably cause serious interference with future scientific research because of the development of more sensitive equipment.

The observations and experiments to be made on West Ford are likely to be difficult to perform and will, in many ways, be similar to those carried out by the authorities responsible for operating West Ford. Moreover, much specific information such as precise and up-to-date ephemerides will be required. The International Astronomical Union will attempt to arrange for rapid and full co-operation among astronomers making observations and calculations, and to provide for world-wide dissemination of their results conforming to accepted standards of scientific research.

*Letter of August 11, 1961, from Dr. J. B. Wiesner to Dr. L. V. Berkner.

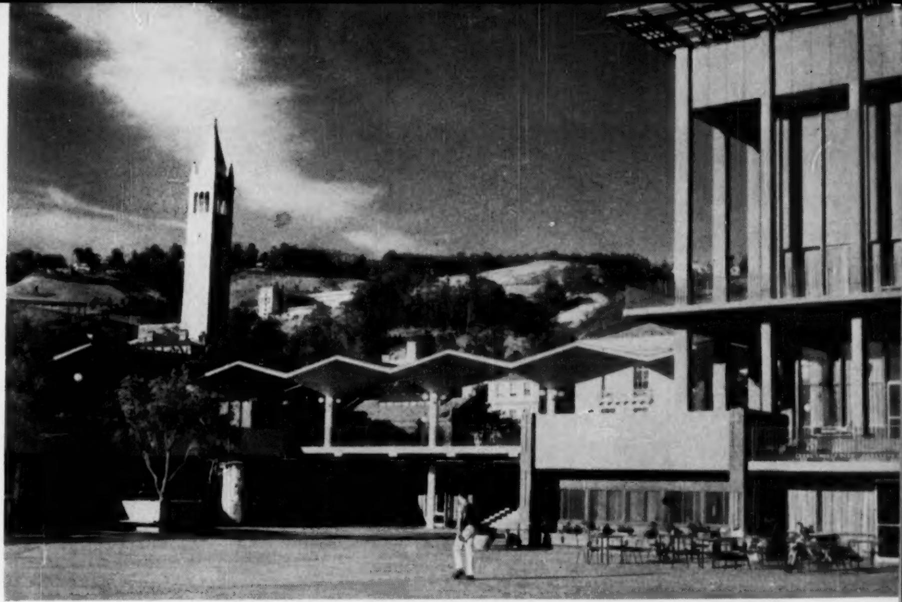
The International Astronomical Union welcomes the position taken by the Government of the United States that any decision on later experiments of the West Ford type will be taken in the light of the results obtained from the presently proposed experiment. To enable the International Astronomical Union to obtain the necessary data, it requests the Government of the United States to grant full privileges to a group of astronomers, acceptable both to the Government and to the Union, to co-operate with West Ford authorities in performing quantitative experiments to determine the properties of the proposed belt of dipoles, its changes with time and location, and its impact upon present and future astronomical research.

Vice-president R. H. Stoy directs the Cape Observatory in South Africa, a center for star cataloguing and astrophysical studies of the southern skies.



Harvard's Leo Goldberg, a well-known theoretical astrophysicist, is chairman of the United States national committee on astronomy. Much of his recent work has concerned the sun.

IAU Field Trips and Social Events



The university campanile is at the left in this view looking northeast toward the Berkeley hills, with the student union building at the right.

CALIFORNIANS in Berkeley accorded a fine welcome to the IAU participants at the 11th General Assembly. For astronomers and their families, well-planned field trips and social hours stimulated personal and professional associations with colleagues from 36 nations all over the globe.

The Berkeley campus of the University of California is on a hillside rising from the eastern border of San Francisco Bay. Each morning's cloudiness gave way to afternoon clearing, and looking westward through the August haze the delegates could view the Bay Bridge, San Francisco, and the Golden Gate.

The nerve center for all IAU extracurricular activity was the registration and information desk, located in the modern university residence halls, where most of the delegates were housed. Here dates were reserved for the sightseeing tours, times of consulate receptions were announced, visa questions answered, and transportation arranged. Here an astronomer could type a report, arrange to have his children cared for, and plan postassembly trips to California observatories.

Presiding over the operations of the desk was the chairman of the assembly's organizing committee and his wife, Dr. and Mrs. C. D. Shane, who together carried out the entire local arrangements for the meeting, assisted by many persons from the university and Lick Observatory. With tireless energy, Mrs. Shane conducted an efficient registration, yet her attention to any individual problem or question made her known to every IAU delegate.

A busy three-hour tour of San Francisco was conducted many times during the assembly for IAU visitors not previously acquainted with this fascinating city. The financial and business sections of Market Street and Union Square, Chinatown, Fisherman's Wharf, and the Palace of the Legion of Honor, with its commanding view of the Golden Gate and the Pacific, were included in the itinerary. A floral welcome to the IAU was on display in Golden Gate Park, where many astronomers attended the space science program of the Morrison Planetarium.

The city was also viewed from the water, during bay sightseeing cruises that departed from the Berkeley yacht basin, circled Angel Island and Alcatraz and passed near the Golden Gate, the trip requiring two hours.

Muir Woods National Monument, famous for its stand of redwood trees towering 350 feet above the glade floor, was the featured stop on an excursion via three bridges: the Bay from Oakland to San Francisco, the Golden Gate, and the Richmond-San Rafael. One bus on this tour caught fire in Berkeley and was pursued by a local motorist for two blocks before he halted it. As the bus driver began looking for aid, the local fire chief happened to drive by; he radioed the nearest station, and soon two hoses were in operation. The tourists were invited to wait in a nearby house until the smoke had cleared. Later, each passenger was awarded a souvenir fire bell by C. H. Smiley of Brown University for use in the next appropriate emergency.

While many informal gatherings of IAU delegates took place in residence halls and Berkeley expresso shops, the palatial Claremont Hotel overlooking the city was chosen for the two formal social events. On August 16th the University of California honored IAU participants at an evening reception, which included dancing, refreshments, and a performance of the hotel's animated fountains under colored spotlights. In the receiving line were Chancellor and Mrs. Edward Strong of the university and officers of the IAU. After the band departed at 11 p.m., dancing continued to the lively piano playing of Sproul Observatory astronomer Peter van de Kamp, until the hotel staff began turning out the lights.

Candlelight and fresh California flowers decorated the Garden Room of the hotel for 700 persons at the meeting's closing banquet on the 23rd. Toasts to the union and its fostering of international cooperation in astronomy were proposed by

Dr. C. D. Shane and his wife. He was chairman of the assembly's organizing committee, and is a former director of Lick Observatory. Photographs with this article not otherwise credited are by the Sky and Telescope staff.

Some guests at the head table for the closing dinner were (left to right) V. A. Ambartsumian, Burakan Astrophysical Observatory, new president of the IAU; Mrs. B. Lindblad; D. H. McLaughlin, regent of the University of California; Mrs. L. Goldberg; O. Heckmann, Hamburg Observatory, host for the 1964 General Assembly; Mrs. D. H. Sadler; and A. Danjon, Paris Observatory.

delegates from Belgium, Australia, Japan, Greece, and Argentina; they were answered by IAU president Jan H. Oort.

By far the most popular excursion was to Lick Observatory, almost all of the 947 registered participants making the 2½-hour bus trip to Mount Hamilton. They went on four separate days, up to 250 at a time. The large buses had difficulty with the hairpin curves and steep grades of the typical mountain road from San Jose to the observatory. On Saturday, August 19th, one bus cut a corner too closely and broke an axle, almost blocking the way. On another occasion, the return trip was delayed by a landslide.

Aided with charts of the mountaintop and the main building's layout, the visitors inspected the laboratory, 36-inch refractor, 120-inch reflector, and 20-inch astrograph. Those who wished also visited the double star catalogue room, the machine shops, and the 36-inch Crossley reflector. They viewed a model of a completely automatic measuring engine and data-storage facilities that will be used for finding extremely precise star positions from the 17-inch-square astrograph plates.

Of prime interest was the 120-inch reflector. After seeing the coude-spectrograph room and the aluminizing tank, the delegates visited the immaculate main observing room, where they were shown how an observer rides up the dome opening and enters the prime-focus cage. The original cage is being partly rebuilt to give more room for instruments on the side opposite to where the observer sits.

Being completed in the machine shop is the 120-inch's prime-focus spectrograph pictured below. It will use several interchangeable reflection gratings, carried in the rectangular container at the lower right. Light from the main mirror will pass to the collimator mirror through a hole in the center of the grating. At the top of the housing, the large knurled knob provides for micrometric focusing.

The famous 36-inch refractor was used in the early evenings for some high-power viewing of the moon and planets, preceded by a delightful outdoor supper in the main courtyard of the observatory. Mount Hamilton has impressive views of evening sunset and of the Sierra Nevada range to the east. Many of the visitors descended the short, steep path to the

This view of Lick Observatory's 120-inch telescope dome is seen by travelers who climb Mount Hamilton and take the road eastward toward Livermore.

Using this compact spectrograph, an observer in the prime-focus cage of the 120-inch reflector will obtain the spectra of very faint objects. A solid-Schmidt camera, f/0.5, fits over the large circular opening. At bottom center is a housing for comparison spectrum sources. On the left is a small telescope for viewing the slit and guiding the exposure. The scaled rack at lower left is for an auxiliary viewing system, to be used for offset guiding on field stars; a similar rack is invisible on the far side of the housing. Lick Observatory photograph.

Crossley telescope, which was given to Lick in 1895 (see August issue, page 67).

Sightseeing and sociability were combined during the Sunday trip to wineries in the Napa Valley, about 60 miles north of Berkeley. Vast prune-plum orchards and vineyards decorate a region already beautiful with rolling golden hills and dark green and brown mountains. The sunshine was quite warm, and the 800 visitors enjoyed cooling off in wine storage tunnels while sampling the vintages.

Six wine-making firms played host to the astronomers, who then gathered on the lawn of the Charles Krug Winery for a fine Armenian dinner, prepared by George Mardikian and his staff from Omar Khayyam's Restaurant in San Francisco. The feast of rose petal preserves, stuffed grape leaves, shish kebabs, and paklava culminated a memorable day.

The 300 ladies attending the program could in no way feel neglected by the organizing committee, for events from afternoon teas to shopping excursions and tours of architecturally interesting homes were provided while their husbands were busy with commission sessions. Berkeley hostesses opened their homes and gardens in a series of morning coffees for groups of eight visitors selected from several countries. The conversation brought out inevitable comparisons of climates and observatories; a remarkable number of astronomers' wives have lived in many parts of the world while accompanying their husbands on stays at various institutions.

Several musical programs arranged especially for the Berkeley assembly were much enjoyed. Folk songs from various sections of the United States were sung by Sam Hinton, a zoologist at the Scripps Institution of Oceanography in La Jolla, who accompanied himself on the guitar. The Sidney Griller string ensemble presented a program featuring two concertos by Sir William Herschel, for violin and for viola.

Laden with fruits and delicacies, tables at the Napa Valley barbecue await the astronomers and their guests. Host C. Mondavi is at the microphone, with Dr. Shane at his right and George Mardikian to his left.

"This is a rare opportunity to hear music written by one of your colleagues," stated Vincent Duckles, head of the University of California music library. "Herschel's decision to become an astronomer represented a clear choice between competence and genius." The Griller string quartet performed three works, the most famous being the well-executed impressionistic quartet by Maurice Ravel.

On exhibit in the main library of the university during the assembly were rare and historic astronomical books. Entitled "Two Thousand Years of Astronomy," the display included Huygens' *Worlds Discovered* of 1698, in which he argued for the inhabitability of other planets, memoirs by Herschel and Halley, and the first editions of Newton's *Philosophiae Naturalis Principia Mathematica* (1687) and Einstein's *Zur Elektrodynamik bewegter Körper* (1905). In this epoch-making memoir, Einstein discussed special relativity and its astronomical implications.

On leaving Berkeley, astronomical visitors carried with them the remembrance of a meticulously planned meeting. One instance of this planning was that each delegate's identification badge carried colored dots to indicate which languages he spoke – blue for English, gold for French, and so on. The convenience of this was obvious at this polyglot gathering when, for example, a Yugoslav astronomer met a Spanish colleague and knew at once that French was their common language.

Astronomers and their wives relaxed with coffee and conversation. At the left, G. Van Biesbroeck, Yerkes and McDonald Observatories, and N. Stoyko, Paris Observatory, talk between commission meetings. At the right, Miss L. M. Volders, the Netherlands, and Mrs. S. Hansen, U. S. A., chat with Mrs. Brewer of Berkeley (standing) prior to visiting her home.

This view from the garden on the east side of the building shows the inclined stem of the T-shaped museum on the equator. An antique solar chronometer is mounted on the pedestal in the foreground. All photographs with this article were taken by Julio Garzon and are courtesy of the author.

A Solar Museum at the Equator

HAZEL O'HARA

CITIZENS of Ecuador have the terrestrial equator always beneath their feet and its celestial counterpart over their heads. A monument, pictured on the opposite page, marks the imaginary line at a point about 15 miles north of Quito, the capital city of Ecuador.

The road from the little town of San Antonio de Pichincha to the monument bears the misleading name Avenida Equinoccial, and many visitors believe they are driving along the equator. The road actually runs at an angle of 45 degrees to the equator.

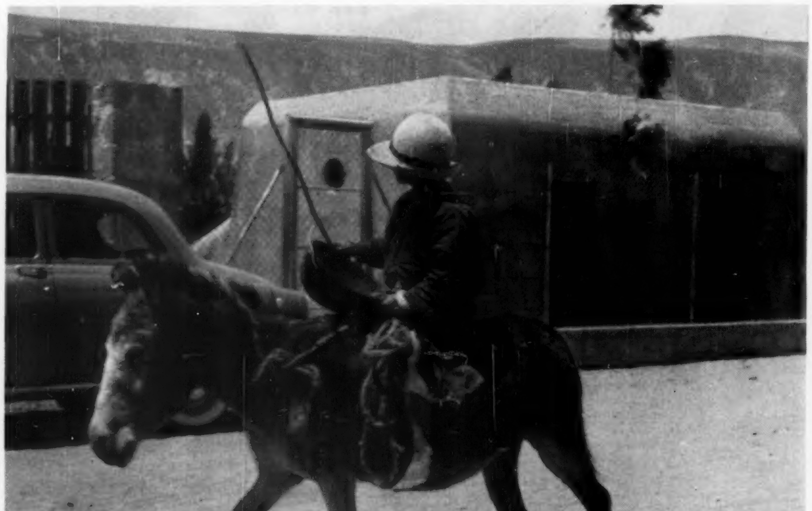
To help clear up many popular misconceptions, Luciano Andrade Marin built a solar museum exactly on the equator, east of the monument. It is a small stone building modeled after 1,000-foot-long mausoleums called tolas that were constructed by the Quitus. This ancient Indian tribe was doing fine stonework before the time of Charlemagne.

The museum is T-shaped and oriented so that the equator runs along the tailpiece. There are two entrances, marked Northern Hemisphere and Southern Hemisphere, in the crossarm of the T.

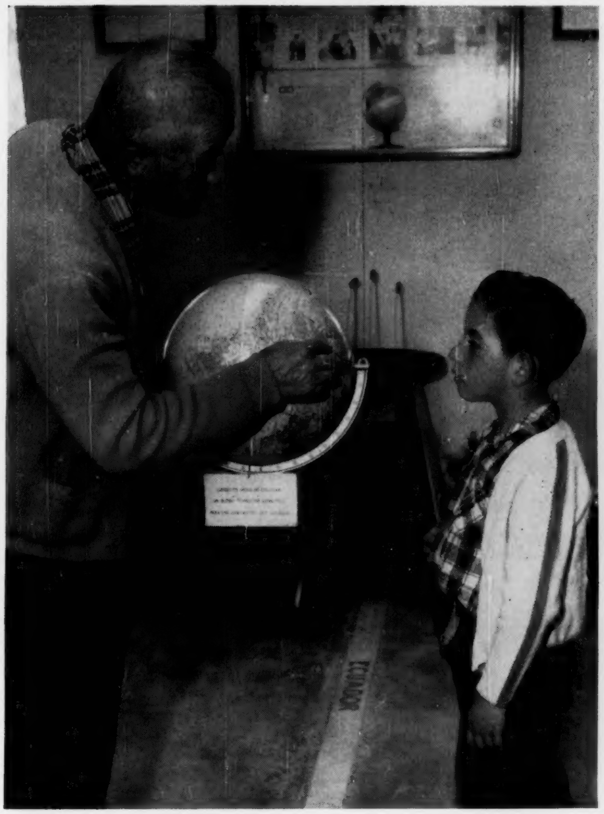
Here a visitor will find Senor Andrade, professor of geography and climatology at the University of Quito, on most weekends. With the aid of many maps, models, and photographs, he explains seasonal changes, relations between the celestial and terrestrial equators, motions of the sun, and the sun lore of ancient peoples.

Professor Andrade believes the T shape may have been one of man's earliest symbols for the universe and divinity, and for comparison with his photographs of tolas, he has pictures of similar structures in the Egyptian Valley of the Kings. There are also displays illustrating the cult of the sun that flourished in the Andean highlands before the coming of the Spaniards.

Seasonal phenomena are particularly well demonstrated by the gardens at the north and south sides of the building. Because of the shadow cast by the museum itself, flowers on one side lie dormant while those on the other burst with blossoms. Six months later, when the sun has crossed the equator, the seasons are reversed and formerly waiting plants are in bloom, while those in the other hemisphere are shaded.



A young Ecuadorian has just crossed the equator, which passes between the doors of the museum in the background. On the facade is an effigy of the paternal and enigmatic sun-god of the Quitus, Indians who inhabited this part of the highlands of Ecuador before the Spanish conquest.



With teaching aids located both inside and outside his museum on the equator, Prof. Luciano Andrade Marin helps many tourists and Ecuadorians to understand the scientific phenomena and historical background of this location. His commentary ranges from ancient Indian lore to the latest findings concerning the dimensions and shape of the globe.

In the gardens, in addition to the two-faced sundial shown on the cover of this issue, are a solar chronometer and the upright cylinder shown at top right. The chronometer belonged to the French scientist C. M. de la Condamine and has been owned by members of Professor Andrade's family since 1735. This instrument indicates noon with high precision and is regularly used by visitors who wish to check their watches.

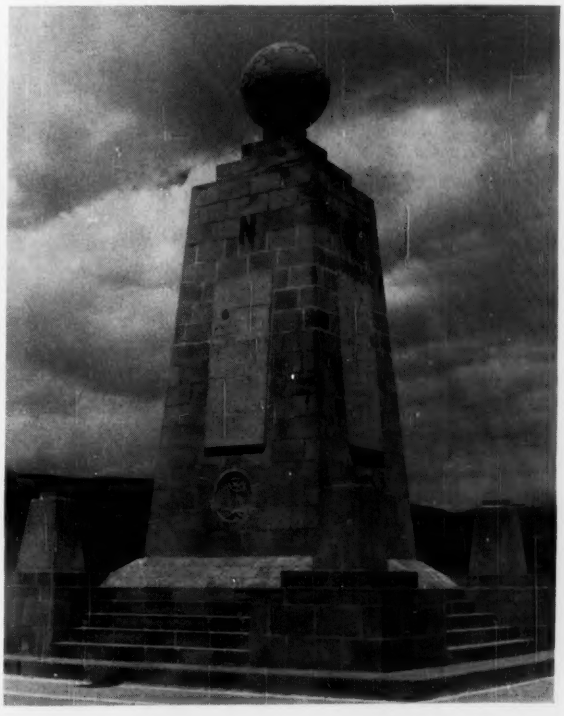
On the cylinder the professor has painted in Spanish, "A small-scale model of the cylindrical structures used by the ancient natives of Quito for determining with great precision the dates of the equinoxes by observing the verticality of the sun above the terrestrial equator when the shadow of the cylinder did not fall either inside or outside of it."

Because this happens only at noon on two days of the year, Professor Andrade has hung a cord from the skylight in the museum. During the entire day at either equinox, the shadow cast by this vertical marker falls along the equatorial stripe painted on the floor. This line can be seen in the picture above.

A globe suspended in a horizontal position serves to demonstrate the manner in which the sun illuminates the earth at other times of the year. Other simple teaching aids, such as a model made from wire and bottle caps, illustrate the relative positions of earth and sun at solstices and equinoxes.

A member of a civic-minded family, Professor Andrade donates his time to spreading knowledge and increasing interest in the natural sciences among the people of Ecuador and tourists who visit the equator.

This obelisk bearing the legend "Latitude 0° 0′ 0″" stands on the equator at an altitude of 7,970 feet above sea level. It was erected in honor of the French scientist Charles Marie de la Condamine (1701-44). In 1735 he led a geodetic expedition to this part of South America, in order to measure the length of an arc of the meridian and thereby determine the size and shape of the earth.



The Western Amateur Astronomers at Long Beach, California, August 24-26, 1961. Photograph by Harry V. Merrick.

Convention at Long Beach

ALAN McCLURE, *Los Angeles Astronomical Society*

THE Lafayette Hotel in Long Beach, California – just a stone's throw from the ocean – was the site of the 12th annual convention of the Western Amateur Astronomers. From August 24th to 26th over 200 amateur and professional sky watchers shared thoughts and experiences.

Host for the well-run convention was the Excelsior Telescope Club of Long Beach. After registration early Thursday morning, the program got under way. Visits with British amateurs were recounted by Dr. Joel W. Goodman, Mill Valley, California, who later conducted the sessions of the Association of Lunar and Planetary Observers held together with the WAA. Contributions to selenography were discussed by Leif J. Robinson of Torrance, California. Capt. C. Adair, Santa Barbara, told of a dozen famous telescopes, and Claude Carpenter of Romoland described his visits to Mount Stromlo and other Australian observatories.

At the WAA star party, Frank Grow's 16-inch reflector was a popular instrument. Leif J. Robinson, Los Angeles Astronomical Society, views Jupiter, while at the left some young astronomers await their turns.

During the afternoon session, Ernest Lorenz, president of the Excelsior Telescope Club, spoke on stars in the sun's neighborhood. His fine fluorescent model depicting these objects was on display, as were a great many telescopes and other projects by delegates. Jack Eastman, Manhattan Beach, California, gave a paper by Thomas Cragg, Leif Robinson, and himself on their observations of the recent supernova in NGC 4564, a galaxy in the Virgo cluster.

The first Morrison lecture of the convention, sponsored by the Astronomical Society of the Pacific, was given Thursday evening by Dr. Dinsmore Alter. The former director of Griffith Observatory spoke on the origin of lunar rays.

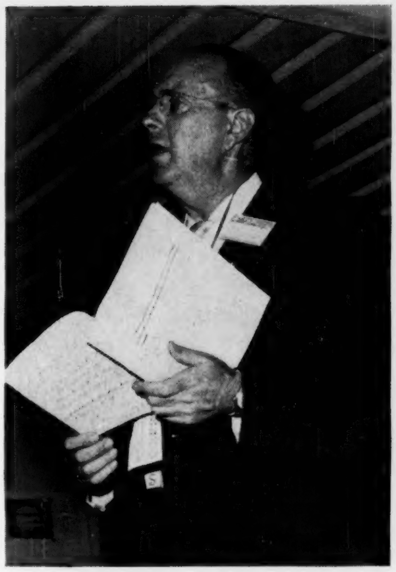
Friday morning and part of Saturday were scheduled for ALPO talks, and 13 papers from many different countries were presented. Topics included new data on the rotational period of Saturn, the short-lived bright spots on Mars in 1958, ultraviolet photography of Venus, and banded lunar craters.

Friday afternoon Dr. George O. Abell, University of California at Los Angeles, gave the second Morrison lecture, on the extragalactic distance scale. He described

methods for determining celestial distances, from the nearest star to the farthest cluster of galaxies. Next there was a talk on the distribution of meteoritic material around Barringer Crater in Arizona, by O. Richard Norton of the Morrison Planetarium in San Francisco. Dr. Clarence P. Custer of Stockton, California, explained how to use the *American Ephemeris* for finding local sidereal time. A panel of amateur experts, consisting of Arthur Leonard, George Carroll, Roy K. Ensign, Carl Wells, and the writer, discussed problems of designing telescope mountings and aligning portable instruments on the north celestial pole.

The nearly total eclipse of the moon was the main event at the well-attended Friday evening star party held at Long Beach city park. Numerous telescopes ranging from Frank Grow's 16-inch reflector to tiny refractors were put to good use, Jupiter and Saturn being almost as popular as the moon. Leif Robinson detected markings on Ganymede, and suggested that a number of observers make drawings, using two 10-inch telescopes. Later comparisons of the eight sketches showed that everyone saw similar detail on the tiny, bright disk of this satellite of Jupiter.

Dr. Gerard de Vaucouleurs, University of Texas, opened Saturday's program with the final Morrison lecture, "The Mapping of Mars." He described how observations of many years are employed to obtain improved accuracy in the positions of Martian features. While he does not believe the "canal" markings are fine lines, he does think that they have an order that is not due to the observer's eye alone. The talk concluded with a discussion of the difficulties of constructing and coloring globes of Mars.



J. Russell Smith of Eagle Pass, Texas, described teaching astronomy to children in school grades 1 to 9. All photographs are by the author unless otherwise credited.

Mr. Carroll ran the latest Lockheed Solar Observatory time-lapse motion pictures of the sun, which show flares causing what appear to be shock waves (Sky and Telescope, March, 1961, page 145). Gasps of astonishment were heard as some of the more striking bursts and waves were projected. Two other fine astronomical movies were greatly enjoyed: Walt Disney's cartoon Mars and Beyond and the National Film Board of Canada's Universe.

Saturday afternoon concluded with papers on satellite tracking, teaching astronomy in grade and high schools, and simple tests of suspected meteorites.

The Starlight Room of the Lafayette was appropriately the scene of the closing banquet. Noted character actor Emory Parnell entertained, and then Dr. Robert S. Richardson of Griffith Observatory gave an amusing survey of little-known hazards facing anyone contemplating a career in astronomy. The writer received an ALPO award for his work on comets, and the G. Bruce Blair gold medal was presented to Carl Wells of Roseville, California, who told of his association with the late Professor Blair and the part the latter played in forming the WAA.

Honolulu, Hawaii, was selected as the site for the next WAA convention, following receipt of letters of invitation from the Hawaiian Astronomical Society, the mayor of Honolulu, and the governor of the state. Earle G. Linsley will be chairman of the 1962 meeting. It is now estimated that the Pacific Ocean round trip transportation will cost about $160, but this figure may be reduced.

Above: Thomas Cragg, an amateur astronomer turned professional and now working at Mount Wilson Observatory, spoke on his observations of eight variable stars, three of which he discovered while watching other variables.

Right: Carl Wells, Roseville, California, this year's recipient of the Blair medal, looks through a monochromator to see prominences on the sun. The instrument's builder, George Carroll, is at the right in the picture.

ASTRONOMICAL SCRAPBOOK

The Companion of Rigel

EVER SINCE the days of Sir William Herschel, Beta Orionis has been familiar as a double star to users of small telescopes. About 10 seconds of arc south of the glaring zero-magnitude primary is a fainter star, of magnitude 6.8 according to photometric measurements. More than a century's micrometer observations have shown very little change in the position angle and separation of this pair. Thus the companion, Rigel B, shares the proper motion of Rigel A, and their radial velocities also agree. Presumably the two stars are moving through space together, forming a binary system of extremely long period.

About 20 years ago, at Mount Wilson Observatory, Roscoe Sanford established that Rigel B is a spectroscopic binary star, with an orbital period of 9.86 days. Because two sets of spectrum lines were recorded, it was evident that the two stars differed little in brightness. At Rigel's distance of about 900 light-years, the angular distance between the components of the spectroscopic pair is far too small for observation in any telescope. Sanford's discovery cannot be used to explain the story now to be told.

The companion to Rigel has posed an unsolved problem to three generations of double star observers: Is Rigel B a very close visual double, in rapid orbital motion?

The question of duplicity was first raised by S. W. Burnham. In the winter of 1871, soon after he had begun searching for new pairs with his 6-inch Clark refractor, he suspected a slight elongation of B. Later, in 1878, he examined the star with the 18½-inch telescope of Dearborn Observatory, and on two nights measured the position angle of what he regarded as a real elongation of the image. The following summer, Burnham took his 6-inch to Mount Hamilton in California, to test the proposed site of Lick Observatory, and on five occasions noted Rigel B as an unresolved double.

In this way, the companion of Rigel entered the list of new Burnham double stars as β555. The American astronomer never again saw it as other than single. Inspection with the 18½-inch in 1880-82 left him undecided, and his repeated examinations with the Lick 36-inch refractor in 1889-91 showed the star as round, even with powers as high as 2,600x, under the best seeing.

So far no other double star observer of the first rank had confirmed the duplicity. Burnham himself expressed some doubt as to the reality of the observed elongations.

The difficulty of checking whether or not a star is actually a very close double should be stressed. Imagine that you are viewing it through a large refractor with a very high power. If the seeing is very good, you will be watching the sharply defined spurious disk, surrounded by some stray light and one or more diffraction rings. Usually, however, this pattern is in constant motion, dancing, twitching, wavering, and blurring from time to time. Is the small, bright central disk really slightly pear-shaped, or are you only seeing a deformation due to imperfect seeing? And if after long scrutiny you decide the image is elongated, have you been entirely free from bias by previous reports?

After Burnham ended his connection with Lick Observatory, he asked the observers there to keep watch on Rigel B. This led to seemingly decisive results. In 1898-99, R. G. Aitken, W. J. Hussey, and E. E. Barnard all measured β555 with the 36-inch refractor as an unresolved pair, elongated in a north-south direction. Aitken's observations of the separation give an idea of the extreme difficulty of the pair: in 1898, 0″.16; 1899, 0″.14; 1901, no elongation; early 1903, 0″.10; late 1903, 0″.05. All of these estimates were obtained with powers between 1,500x and 3,000x. (The theoretical limit of resolution for a 36-inch telescope is 0″.15, according to Lord Rayleigh's formula.)

Although Aitken kept an intermittent watch until 1934, he never again noted Rigel B as double except on four nights in 1911 as a 0″.1 pair. In his long report on this star in Vol. 12 of the *Publications* of Lick Observatory (1914), he wrote:

"I have examined this pair, with negative results, on many nights besides those recorded here, and I am quite unable to frame any hypothesis to account for all of these failures. I have no hesitation in stating that the star was certainly double in 1898-99 and in 1911. The measures in January, 1903, I think are also reliable; the later ones of that year are obviously more uncertain."

Two other pieces of positive evidence warrant mention, because of the great skill of the observers concerned. One consists of measurements on three nights in 1925 by W. H. van den Bos with the 26½-inch refractor at Johannesburg, South Africa, the separation being estimated as 0″.18. The second is P. Muller's record of the star as a 0″.1 pair on two nights in 1953, with the Lick 36-inch refractor, magnification 1,500. But it should be added that van den Bos on later examinations did not obtain positive results, and his present opinion is that the duplicity of Rigel B is an open question.

There is very strong negative evidence. One of the ablest of living double star observers is G. Van Biesbroeck, who has used the Yerkes 40-inch refractor for 45 years, and also the McDonald 82-inch reflector for over a decade. Although he has frequently checked the companion of Rigel, he has never been able to verify definitely that it is a visual double star.

Of particular importance is the series of interferometer observations carried out by W. S. Finsen for over 10 years with the 26½-inch Johannesburg telescope. Rigel B at magnitude 6.8 is sufficiently bright for interferometer work; the equality of brightness of the components, as reported by Burnham and Aitken, is a favorable circumstance; and the stray light from Rigel itself does not interfere. Nevertheless, Finsen's frequent interferometer examinations have failed to show the star as double; either it is single, or the separation was on each occasion less than about 0″.1.

Finsen's work provides an enlightening clue. The previous observations had made it plain that if the star is a visual double at all, it is a rapidly revolving binary with an elongated orbit such that the pair is usually too close for even the largest refractors. What Finsen's work has made virtually certain is that the maximum separation is under 0″.1. Hence a large part of the published measures, and in particular those with small apertures, are spurious. Especially, Burnham's initial observations with a 6-inch telescope have to be discarded. Thus, if Rigel B is really a visual double, his discovery was a mistake!

There is a suggestive circumstance common to the positive observations by Aitken, van den Bos, and Muller. In each case, they reported Rigel B as double when, after having used smaller telescopes, they were becoming acquainted with the performance of large apertures. But then, after long experience with very large refractors, Aitken and van den Bos stopped seeing Rigel B as definitely double. Another psychological factor is that the enormous reputation of Burnham probably created a predisposition in favor of duplicity in some observers' minds.

Is the companion of Rigel a visual pair or not? After 90 years, the question is still undecided. Perhaps we shall know the answer after interferometer work on very close binaries becomes a program of one of the giant reflecting telescopes in California.

JOSEPH ASHBROOK

NEW INSTRUMENT AT FELS PLANETARIUM

The Fels Planetarium in Philadelphia, the second oldest in the United States, is to receive a new improved Zeiss projector. Installation will begin during the last week in June, 1962, with the planetarium's reopening scheduled for August.

The new equipment is being purchased with a $175,000 grant from the Samuel S. Fels fund. The Franklin Institute's present instrument was purchased in 1928 by Mr. Fels and began operation in November, 1933.

I. M. Levitt, director of the planetarium, estimates that the old projector has run approximately 24,000 hours, presenting the skies to some 4,250,000 visitors.

T Tauri Stars and Associated Nebulosities

OTTO STRUVE, *National Radio Astronomy Observatory**

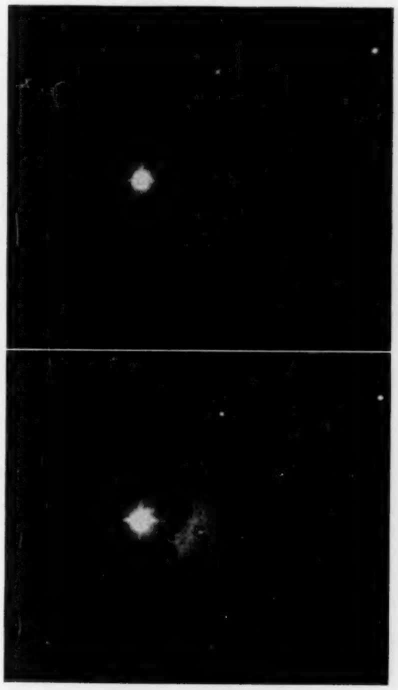
TODAY many astronomers are paying special attention to the T Tauri stars — dwarf irregular variables occurring in dark nebulae and characterized by emission lines in their spectra. The most famous member of this group is T Tauri itself, which illuminates a reflection nebula discovered by J. R. Hind in 1852.

This nebula, NGC 1555, is remarkable for its brightness changes. Their history has been summarized by G. H. Herbig in *Leaflet* No. 293 (September, 1953) of the Astronomical Society of the Pacific. Hind's discovery was made with a 7-inch refractor, and between 1852 and 1861 several astronomers observed the nebula. In the latter year, H. d'Arrest reported that the object had disappeared, although he had seen it easily several times in 1855 and 1856. In the largest existing telescopes, however, faint traces were discernible until 1864.

Hind's variable nebula was not again detected until 1890, when E. E. Barnard and S. W. Burnham found it with the Lick 36-inch refractor as an exceedingly faint object. Beginning in 1899 there are photographic records of NGC 1555. About 1920, it began to brighten gradually, and now is readily visible in large telescopes. This change is shown by the accompanying Lick Observatory photographs taken in 1914 and 1952.

These alterations in the brightness and form of Hind's nebula are due to varying illumination from the star T Tauri. As Herbig remarked: "It seems likely that the clouds, which a century ago were so brightly lit up by T Tauri, were not dissolved about 1861, but rather they disap-

*Operated by the Associated Universities, Inc., under contract with the National Science Foundation.



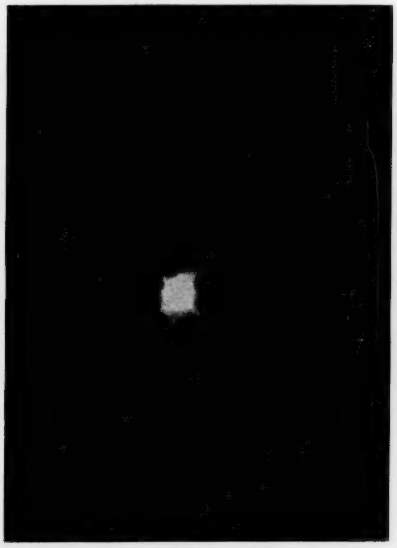
In 1914, when the Crossley reflector was used for the upper picture, the nebula to the west (right) of T Tauri was too faint to reproduce well. In the lower picture, taken with the same telescope in 1952, the nebula has become much brighter.

peared when the shadow of something nearer the star swept across them. We are probably witnessing no more than the play of light and shadow on a relatively fixed curtain of dust clouds."

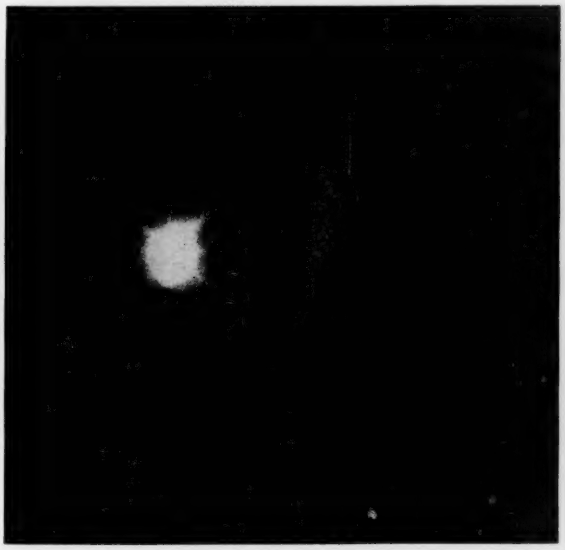
Most of our knowledge of the T Tauri variables has come from the work of three astronomers, A. H. Joy at Mount Wilson and Palomar, Herbig at Lick, and G. Haro at Tonantzintla Observatory in Mexico. In recent years, Herbig has thoroughly discussed the physical properties of these stars, especially with regard to their spectra. The light curves are irregular, often with long intervals of quiescence, but there are many other kinds of irregular variables and it is not possible to assign a particular variable to the T Tauri class on the basis of its light curve alone. All of the real T Tauri stars have late-type spectra with strong emission lines of hydrogen and ionized calcium. In addition, they often show weaker emissions of helium, iron, and a few other chemical elements.

Confirming earlier work by Joy, Herbig has concluded that the T Tauri variables are always associated with obscuring clouds of interstellar dust. They are particularly numerous in such great aggregations of interstellar material as the Taurus-Auriga clouds, the Orion nebula, and the region of NGC 2264 in Monoceros. Often these stars occur in the fringes of dark clouds, and some are involved in dust that produces reflection nebulae. A few of these nebulosities are known to vary in brightness, six cases being listed by Herbig in the *Astrophysical Journal* for January, 1961. One is Hind's nebula associated with T Tauri, another Hubble's nebula NGC 2261, connected with the variable star R Monocerotis, pictured on the next page. The star R is inside the "head" of this comet-shaped nebulosity.

The spectra of T Tauri stars show several remarkable features. At certain stages of the light variation a strong con-



Two recent pictures by the Lick 120-inch reflector show the small nebula, discovered by S. W. Burnham, surrounding the star T Tauri. At the left, it appears as a loop extending down from the star image, also as an extension of the image toward upper right, which makes the star appear noncircular in both pictures. The large glow is Hind's nebula, NGC 1555.



tinuous spectrum is present, appearing to veil the underlying late-type absorption lines. In some stars, this blue and violet continuous emission almost completely obscures the absorption spectrum. The physical explanation of this continuous emission has not yet been found.

In certain T Tauri variables the spectrum shows shell-like absorption lines displaced toward the violet, indicating an outflow of gas from the reversing layer of the star. Herbig believes that there is no evidence in any well-observed variable of this type for an *inflow* of gas, which would occur if the star were accreting matter from the surrounding nebulosities.

A few of the brightest T Tauri stars have been observed by Herbig and Joy with sufficient dispersion to show conclusively that the underlying absorption lines are broad and diffuse. This line broadening, according to Herbig, is probably due to axial rotation of the stars. RY Tauri, for example, has a rotational velocity at its equator of the order of 50 kilometers per second, while its spectral type is dwarf *G*0e. No main-sequence star of solar type – apart from components of binaries – has a rotational velocity this great.

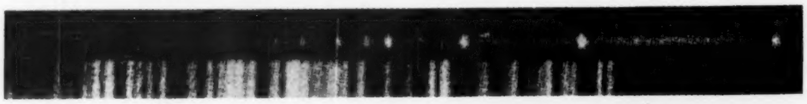
In visual absolute magnitude, all T Tauri objects are considerably brighter than main-sequence stars of similar spectral type. Herbig has suggested that the T Tauri stars are relatively young and still in the process of gravitational contraction. If so, RY Tauri, at present a *G* star, would reach the main sequence in about 10 million years as an *A*7 object, in accordance with the theoretical work of L. Henyey and his colleagues. Thus RY Tauri would become hotter and smaller. Herbig's computations show that its radius would be halved, and conservation of angular momentum would double its rotational velocity. Hence RY Tauri on reaching the main sequence would have an equatorial velocity of rotation of about 100 kilometers per second – a plausible value for a main-sequence *A* star.

There are many T Tauri stars whose present spectral types are between *K*0 and *M*0, and Herbig has pointed out that after evolving to the main sequence they would be *G*0 or later. He expects that these now very cool T Tauri objects, as they contract further, will result in slowly rotating main-sequence stars with equatorial velocities similar to the sun's two kilometers per second. It appears that the angular momentum of such a star may be conserved over a long interval as the star evolves, but the observations are insufficient to prove this conclusively.

Hubble's variable nebula NGC 2261, as shown by the first photograph taken with the 200-inch telescope, in 1949.

As several authors have pointed out, complete conservation of angular momentum is unlikely during the earliest stages of the contraction of a large gas sphere. Theories of the origin of the stars, such as W. H. McCrea's, indicate that an interstellar gas cloud of mass equal to the sun's would have an angular momentum greater than that known for any star. Consequently, if stars evolve by contraction, the earliest stages of the process must be accompanied by a very drastic reduction of angular momentum, and this must happen at an evolutionary stage earlier than that represented by the T Tauri stars we observe.

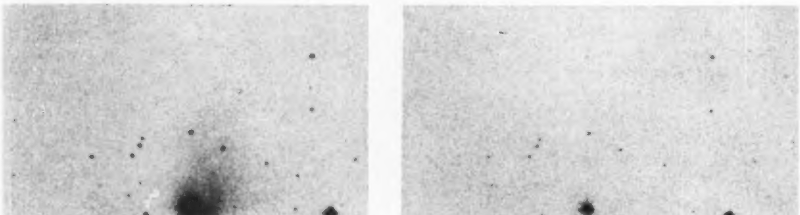
An unexpected spectroscopic feature of T Tauri variables is the great strength of their lithium absorption lines. In these stars there is one lithium atom for every 10,000 of calcium, as estimated by Herbig from his own observations and from those in 1960 by W. K. Bonsack and J. L. Greenstein. By contrast, the solar atmosphere contains only one atom of lithium per 7,000,000 of calcium, according to Greenstein and R. S. Richardson. But in stony meteorites and in the earth's igneous rocks, the abundance ratio is approximately the same as in the atmospheres of the T Tauri stars.



Numerous emission lines appear in this spectrogram of DD Tauri, obtained by the author with the 82-inch McDonald reflector, and published in his 1950 book "Stellar Evolution." This T Tauri-type star lies in the nebula B10.

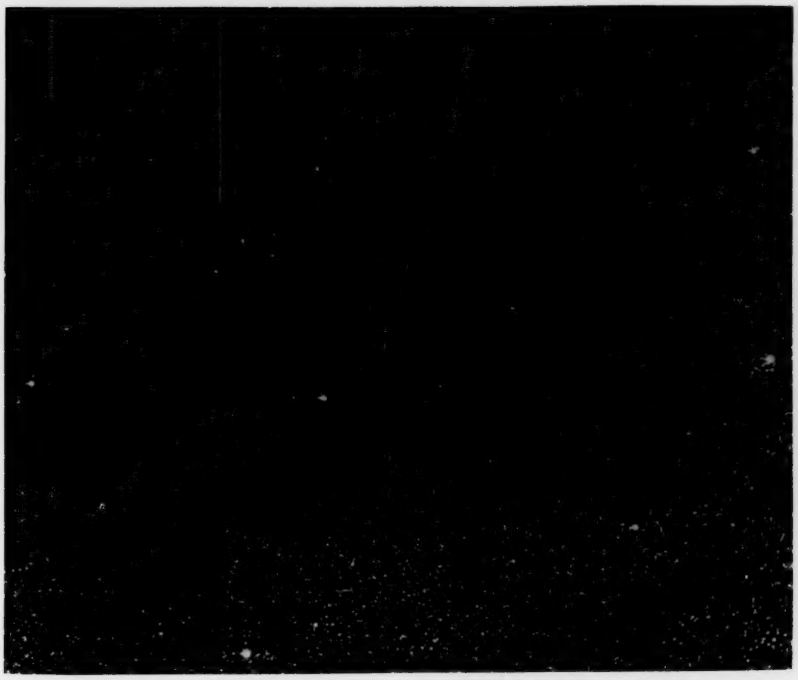
Why so much lithium in these stars? Herbig seems to favor the explanation that their abundance of lithium is normal, and that there is now little of this element in the sun because of depletion by nuclear processes over billions of years. Greenstein supports an alternative hypothesis: In the atmospheres of the T Tauri stars a nuclear mechanism replenishes their lithium, a mechanism that does not work in the sun.

The light variations of T Tauri variables have been studied chiefly by German and Russian astronomers. A particularly valuable summary of observations was published in 1951 by P. N. Kholopov in the Soviet journal *Variable Stars*. Among the variables he studied were some stars described by A. H. Joy in 1949 as having bright lines of hydrogen. Two of these variable stars are less than 30 seconds of arc apart on the sky, and in Joy's list are designated 259-6s and 259-6n. The northern component, CZ Tauri, is about magnitude 16 and is of spectral type d*M*2e; the southern, DD Tauri, is about 15 and has a d*K*6e spectrum. The original discovery of their light variations was by the German astronomer K. Himpel, in 1943.



RY Tauri and its variable nebulosity, discovered by E. E. Barnard, as photographed on January 1, 1957 (left), and March 18, 1960, by G. H. Herbig with the 36-inch reflector of Lick Observatory. Both were 30-minute exposures in blue light. The fading of the nebula is conspicuous.

I became interested in these two stars about 24 years ago because they lie within the confines of the faint but fairly large reflection nebula known as Barnard 10. This is a luminous patch in the central part of Barnard's dark cloud B7. With the 82-inch McDonald reflector I obtained spectrograms of both stars. P. Swings and



Crossing this portion of the Milky Way in Taurus is the dark obscuring cloud Barnard 7, in which appears, just above the center of the picture, the small luminous nebulosity Barnard 10. Compare it with the large-scale view below. From Plate 5 of Barnard's atlas (1927).

I found that the southern one had a strong emission spectrum of hydrogen and ionized calcium, with a few weaker emission lines of helium and possibly other elements. The fainter, northern component could be classified as type *K*, with bright lines of ionized calcium and with strong absorption bands of CH.

The nature of the emission nebulosity Barnard 10 posed an interesting problem. At my request, O. C. Collins photographed it in 1937, and found that this nebula is distinctly blue. At the time I was inclined to believe that B10 owes its light to DD Tauri, whose continuous spectrum is strong in the blue, violet, and ultraviolet regions. The continuous spectrum of the nebula resembled that of DD Tauri and showed a weak hydrogen-beta emission line.

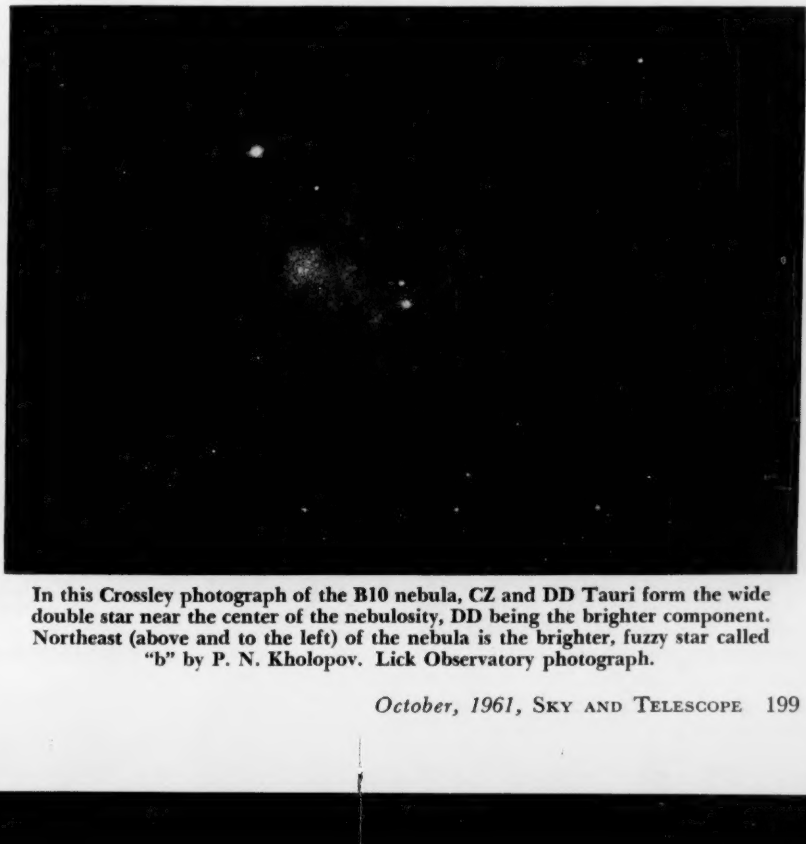
An examination of the Palomar Sky Survey photographs fully confirms Collins' result; the nebula is distinctly bluer than other reflection nebulosities connected with T Tauri stars. As far as can be judged from a comparison of these pictures with earlier ones by Barnard and F. E. Ross, there has been no noticeable change in the brightness or color of B10.

But the Palomar photographs show some structure in the nebula, and I am not now sure that it shines by the reflected light from either CZ or DD Tauri. It may be an extension of the nebulosity that surrounds the comparison star labeled "b" on the finding chart in Kholopov's article. This star is itself embedded in a small reddish nebulosity, clearly shown on the red-sensitive Palomar plate.

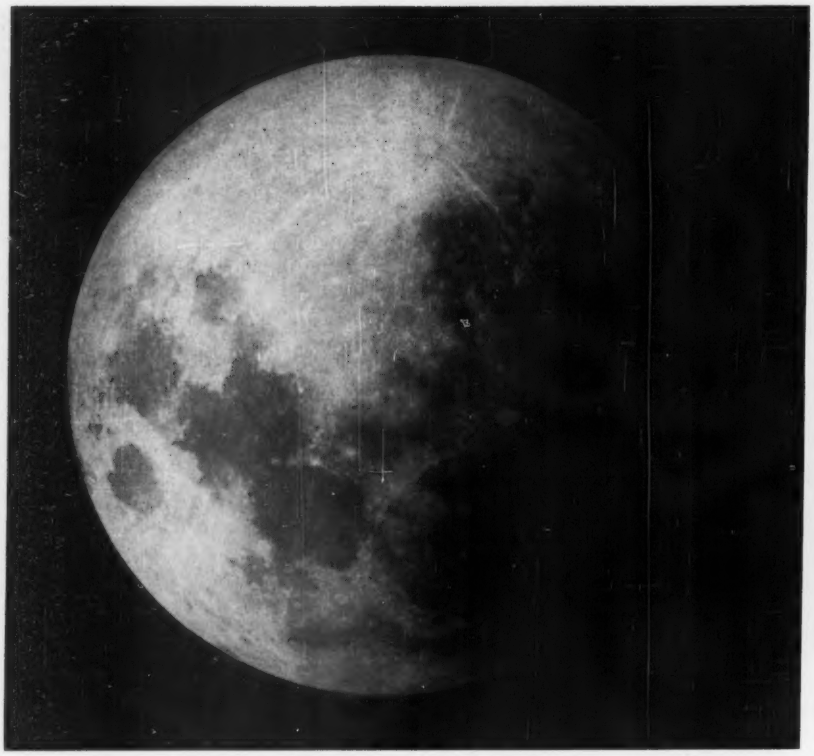
In 1948, Swings and I noted the fact that B10 is much too luminous to owe its brightness to the reflected radiation of DD Tauri. This is easily shown by an argument first developed by E. Hertzsprung in 1913 for the reflection nebulosities in the Pleiades. A perfectly white, diffusely reflecting hemisphere, located some distance from the star, would possess a surface brightness equal to that of an extra-focal image of the star having an apparent diameter the same as the hemisphere. If the image of DD Tauri were spread out over several minutes of arc, the size of B10, the surface brightness would be far less than the nebula's — in fact, the extra-focal image would be undetectable. The result might not be negative in the case of star "b," which is as bright as magnitude 13.7, according to Kholopov.

Even so, there is still the problem of explaining the bluish appearance of B10. Swings and I pointed out that in laboratory experiments many solids show an intense visible fluorescence when they are excited by far-ultraviolet radiation, and in some cases this fluorescence is especially pronounced at low temperatures. However, as far as I know now, B10 is the only blue reflection nebula associated with a late-type star. It seems improbable that some special mechanism is at work without producing similar effects in other cases.

Another puzzle is presented by the luminous nebula B14, which is quite clearly shown on early Milky Way photographs by Barnard and Ross. This nebula is distinctly red, but there is no star in its immediate vicinity that could account for its light — two facts evident from both Collins' photographs and the Palomar Sky Survey. There is some indication that the brightness of B14 has changed in the past quarter century, and perhaps its shape. It may be that in this case there is a T Tauri star so deeply involved in the obscuring cloud that it has not been recorded with even the most powerful telescopes. This phenomenon would be analogous to the effect of a terrestrial cloud layer that is dense enough to blot out the sun's disk, showing only a large luminous patch of scattered sunlight.



In this Crossley photograph of the B10 nebula, CZ and DD Tauri form the wide double star near the center of the nebulosity, DD being the brighter component. Northeast (above and to the left) of the nebula is the brighter, fuzzy star called "b" by P. N. Kholopov. Lick Observatory photograph.



This photograph was taken in Curacao, Netherlands Antilles, at 1:35 Universal time, just at first contact of the earth's umbra. The darkening at that time was due to the penumbral shadow alone. G. A. T. and R. G. Heillegger made the photograph at the Newtonian focus of an 8-inch f/8 reflector, using a deep yellow filter and a 1/150-second exposure on Kodak Plus-X film.

Lunar Eclipse Roundup

SKY WATCHERS from coast to coast saw the moon pass through the earth's shadow on the evening of August 25th. Although few localities enjoyed perfectly clear skies, amateurs in practically every part of the United States could view parts of the pageant.

Along the Atlantic seaboard from Massachusetts to Florida, observers were hampered by intermittent clouds. In the Midwest, reports tell of skies ranging from hazy to clear. Along the West Coast, where the moon rose already in shadow, weather conditions were spotty, but many amateurs made successful observations. The number of visual and photographic records already received by SKY AND TELESCOPE from its readers is so great that only a sampling can be presented here. In particular, publication of the results of numerous timings for crater entrances and exits from the shadow must await another issue.

The August eclipse was noteworthy for being almost on the dividing line between total and partial. As predicted by the *American Ephemeris*, at time of mid-eclipse only 0.8 per cent of the moon's diameter remained outside the dense umbral shadow of the earth. Many observers commented on this striking appearance. At Des Moines, Iowa, D. P. Cruikshank described the pearly white crescent, forming an "opal ring" as beautiful as the "diamond ring" at a solar eclipse. J. D. Carpenter at Earlville, Iowa, likened the moon as seen with the unaided eye at that time to a ring whose stone was the uneclipsed part, and whose band was a light strip running around the moon's edge.

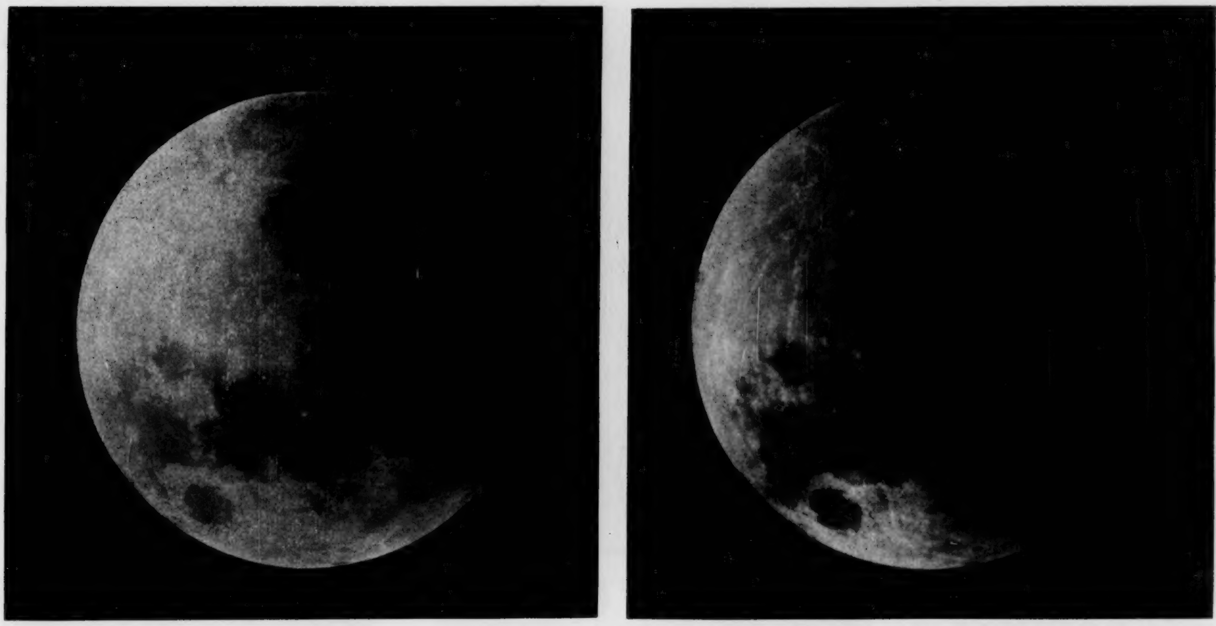
Many amateur organizations held public eclipse parties to help widen popular interest in astronomy. Typical among these demonstrations was that of the Boothe Memorial Astronomical Society at Stratford, Connecticut, where seven telescopes from 3-inch to 6-inch aperture were set up for 70 visitors. One of the largest parties was on the grounds of the planetarium in St. Louis, with the St. Louis Astronomical Society and the McDonnell Aircraft Astronomers Club as hosts. Over 25 telescopes served more than 500 people, who were kept posted on the course of the eclipse with the help of a loudspeaker system.

Some amateurs made expeditions to favorable observing sites to carry out well-planned programs. For example, G. A. Cunningham, III, J. Teti, Jr., and C. Callahan, all of Charleston, West Virginia, traveled 30 miles to set up their instruments on a hill. They made photometric measurements of the changing brightness of the moon, using a CL-3 photoresistor attached to a 2.4-inch refractor. Unfortunately, the intermittent clouds prevented this group from obtaining a complete light curve.

The same team used a 3-inch refractor for photography, with a Kodak 12 filter and Tri-X film. Their third instrument, a $3\frac{1}{4}$-inch refractor, served for visual work. With it, at mid-eclipse the moon was noted as a dull gray, except for the part not in the umbra and for a whitish ring along the rim of the moon.

Among viewers, the consensus was that this eclipse was an unusually dark one.

Many observers gathered at Forest Park in St. Louis, Missouri, to watch the eclipse. Standing at right center in front of his 12-inch reflector is Joe Johnson, showing visitors details of the instrument, which was one of two dozen at the site. In the background is the partially completed St. Louis planetarium. Photograph by Robert E. Cox.



Taken within 14 minutes of each other, these pictures were both made with 3-inch f/15 refractors. The first (left) was by G. A. Cunningham, J. Teti, and C. Callahan, of Charleston, West Virginia, at 1:35 UT. The other, by R. A. Benedict, was processed by R. J. Willett, both of Morristown, New Jersey. Slightly more grain and less contrast are shown by the left-hand picture, made on Tri-X film, compared with the results from Plus-X at the right. Techniques and materials for lunar-eclipse photography can be tested by exposures on the crescent moon and its earthshine.

For a comparison with recent total lunar eclipses, it is necessary to select records of the appearance near mid-eclipse (3:08 Universal time). R. T. Dickinson, Toronto, Canada, who had excellent sky transparency in central Ontario, stated that the moon was very dark as seen with the naked eye. Mr. Cruikshank, working with a 12-inch reflector, noted the core of the shadow as quite dark, but surrounded by a ruby-brick-red ring.

D. Price at Westerville, Ohio, devoted special attention to color phenomena. Shortly before mid-eclipse, the shadow appeared gray with a coppery outer zone, as seen in his 1¼-inch 8x finder. At Stratford, Connecticut, W. R. Winkler noted the eclipse as among the darkest ones he had experienced. Stephen Haufe, at Bloomfield, Iowa, recorded that the copper color noticeable with the naked eye could not be seen in his 2.4-inch refractor at 55x.

Judging from these and other statements, we may assign this eclipse a rating of between 1 and 2 on the Danjon 0-4 scale of brightness, which was explained on page 229 of the February, 1960, SKY AND TELESCOPE.

Interesting hints for observing techniques at future eclipses of the moon are given by Dennis Milon, Houston, Texas, who used a stopped-down 6-inch reflector to secure a long list of crater timings. He tape-recorded CHU time signals, adding voice comments. To identify craters, he used a large full-disk lunar photograph, covered with tracing paper. As the craters were observed, each was marked by a serial number on the tracing paper, thereby saving much time. Mr. Milon's crater timings were taken in rotation through a red filter, blue filter, and no filter, his purpose being to ascertain whether or not the earth's shadow appeared the same size in different colors.

The penumbra, or faint outer shadow of the earth, was given attention by a number of observers. M. Wolek and H. Semel, Saddlebrook, New Jersey, using a 3¼-inch refractor at 44x, first noticed a penumbral darkening of the moon 20 minutes before umbral eclipse began, and believe it may have been visible even earlier. At Olympia, Washington, the width of the penumbral shadow on the moon was estimated as ⅕ the lunar diameter by P. C. Kammeyer, with a 1½-inch, 7x finder. However, the width is given as nearly half the moon's breadth by J. A. Colasurdo, who observed with 7 x 35 binoculars at Hammonton, New Jersey. At future eclipses of the moon, estimates of the width of the visible penumbra should be part of any detailed amateur observing program.

Listed below are the names of correspondents whose eclipse reports had been received up to September 5th, in addition to those specifically mentioned above. SKY AND TELESCOPE thanks them and their fellow observers. An asterisk indicates that photographs were submitted.

J. Baumgardt* and J. Christie, Bakersfield, Calif.; D. Blondin* and W. Yale, Flint, Mich.; D. Bradbury, Dallas, Tex.; P. Brooks, Lawrence, Mass.; H. Butcher*, D. Webber, and G. Fuller, Webster Groves, Mo.; L. Collins, F. Forest, and T. Franz, Newgulf, Tex.

M. De Falco*, W. Covina, Calif.; J. Delafield, New York, N. Y.; E. Duckworth, D.

Three of a set of 38 pictures on Tri-X film taken by Larry Neuweg of West Point, Iowa, showing the moon emerging from the earth's shadow. At left, near mid-eclipse, 3:00 UT; in the center, 3:22; and at right, 4:00. The two left-hand pictures were half-second exposures, while the one at the right was exposed for 1/50 second. All were taken at the Newtonian focus of a homemade 8-inch reflector.

This trailed photograph of the eclipse was a three-hour exposure from 1:45 to 4:45 UT using a stationary Busch Pressman camera with a 135-mm. Zeiss lens. Brightness changes of the moon are clearly shown, the plume at the right and breaks in the streak at left being due to intermittent clouds. The photograph was taken by Helen L. Brooks and her students of the University of Toledo at their observing site near the city's edge.

Weisbrod, H. Dodson, G. Joy, B. Sokol, C. Niman, S. Collier, and T. Smith, El Cajon, Calif.; R. Dudley, Alexandria, Va.; M. Edwards, J. Johnson, and B. Grant, Tulsa, Okla.; H. Eidson, Jr.*, Winston-Salem, N. C.; J. Elk*, Ponca City, Okla.

J. Fisher*, F. Brown, D. Brown, and J. MacDougall, Chatham, Ontario, Canada; R. Giovanoni*, Bath, N. Y.; J. Hannon*, Thomaston, Conn.; T. Hewitt*, Glen Ellen, Calif.; S. Hiss, West Palm Beach, Fla.; C. Howell*, Knoxville, Tenn.; D. Hudson*, La Puente, Calif.; C. Hummel, Huntsville, Ala.; T. Huston*, Shelby, Ohio.

C. Isbell, El Paso, Tex.; C. Kapral*, J. Pepsin, and J. Hizny, Luzerne, Pa.; C. Ketz*, Batesville, Ark.; K. Kirkley*, Austin, Tex.; G. Kniga, Hamtramck, Mich.; J. Kousbaugh, Bremerton, Wash.; D. Kremgold* and T. Dolan, Stoughton, Mass.

W. Langley, Huntsville, Ala.; A. Larson*, Burlington, Iowa; R. Levy*, Cambridge, Mass.; E. Light, New York, N. Y.; J. Lingel*, Lynnfield, Mass.; J. Mancuso, Jr. and P. Mancuso, San Jose, Calif.; D. Martins, Harviell, Mo.; Alan Mass*, Malden, Mass.; J. McGowan, La Puente, Calif.; T. McKenna*, Glen Burnie, Md.; B. McManus, Riverton, N. J.; P. Merz*, Hillside, N. J.; Maj. T. Mote, Lockbourne AFB, Ohio.

J. Nelson, Playa Del Rey, Calif.; R. Papirno*, West Hempstead, N. Y.; B. Provin, Chatsworth, Calif.; J. Randi* and P. Foote, New York, N. Y.; J. Rauff, Detroit, Mich.; M. Redden*, Sioux City, Iowa; F. Reed, P. Spaulding, and L. Hunt, Lebanon, Ky.; D. and J. Riley, Eureka, Ill.; G. Rippen, Madison, Wis.

R. Scharf, Crete, Ill.; W. Shewman, Moberly, Mo.; C. Silverman*, Miami, Fla.; R. Sim, South Bend, Ind.; J. Smith, Sarland, Tex.; H. Solberg, Jr., Las Cruces, N. M.; G. Staples, Portsmouth, Va.; E. Stewart, Austin, Tex.; J. Sunshine, University Heights, Ohio; N. Travis and B. Brown, Farmington, Mich.; E. Turco, Cranston, R. I.

A. Van Til*, Highland, Ind.; D. Vaubel*, La Puente, Calif.; M. Walters, J. Starbird, B. Logan, N. Butler, J. Pavlacka, and F. Pilcher, Topeka, Kan.; H. Wich*, N. Syracuse, N. Y.; B. Wilkinson*, Duncan, Okla.; D. Williams, Normal, Ill.; G. Williams, Park Forest, Ill.; M. Williams, Cedar Rapids, Iowa; D. Wuollet*, St. Louis Park, Minn.; R. Zabriskie*, Hillside, N. J.; N. Zakar and P. Haustein, La Mesa, Calif.; Michael Zeilik*, Stratford, Conn.; G. Zerambo, Jr., Bentleyville, Pa.

At Parkville, Missouri, the bright crescent was overexposed by Wayne Fullerton to show the shadowed moon. He used an 8-inch f/13 refractor with eyepiece projection for this 60-second exposure at 3:41 UT, after mid-eclipse.

LETTERS

Sir:

The techniques of photoelectric photometry have now been simplified to the point where the amateur can use them to make significant contributions to astronomy. The cost of an efficient homemade photometer using a 931A photomultiplier can be as low as $60.00, and it is sometimes possible to make accurate measures of stellar brightnesses to about 12th magnitude using telescopes of only 6-inch aperture. But even though such astronomical research is now open to those with modest instruments, there seem to be very few amateurs undertaking photoelectric work. J. Ruiz and D. Engelkemeir in the United States are well known to readers of this magazine as successful photoelectric observers.

In order to encourage amateurs, I formed a photoelectric observing group early this year. It now has about 12 members, mainly in England, and we are constructing our own equipment. Our telescopes include five with apertures larger than eight inches, and three of over 12 inches are being built. Four of us possess photometers.

Monthly circulars are sent out to coordinate our program, which is the systematic investigation of bright variables listed in the *General Catalogue of Variable Stars* and determination of times of minima for certain eclipsing binaries. The writer has already published a number of papers in this field.

I would like to hear from anyone interested in photoelectric work.

SIMON ARCHER
Rhodes University
Grahamstown, South Africa

Sir:

The Astronomical Society of Switzerland is offering for sale a series of eight 2-inch color transparencies of the magnificent solar eclipse of last February 15th. Taken in Italy, the slides cover the whole phenomenon of totality, from a wide-angle view of the approaching broad shadow of the moon (camera focal length 35 mm.) to photographs at maximum eclipse showing the inner and outer corona, red prominences, and the chromosphere (obtained at several focal lengths up to 1,600 mm.).

The slides, mounted in glass for durability, will be sent registered and postpaid to any country in the world. Payment of $6.70 in U. S. money or Swiss francs 29.00 should be by check; the slides are not for sale singly. Explanatory comments are in English and German.

HANS ROHR
General Secretary SAS
Vordergasse 57
Schaffhausen, Switzerland

COMET HUMASON

On September 1st, Milton L. Humason of Mount Wilson and Palomar Observatories discovered a faint new comet in Pisces, about four degrees south of Beta Andromedae. Moving west at the slow rate of 13 minutes of arc per day, Comet 1961e was described by its discoverer as a diffuse 14th-magnitude object with no tail.

NEWS NOTES

42 COMAE BERENICES

The 4th-magnitude star 42 Comae Berenices is a famous visual binary, having two components of practically equal brightness, revolving around their center of gravity in a period of 25.83 years. Always a close pair, the members of 42 Comae are now separated by only 0.3 second of arc. The orbit is noteworthy for being almost exactly edge on to our view.

In the August *Astronomical Journal*, Sarah Lee Lippincott of Sproul Observatory reports a new determination of the trigonometric parallax of 42 Comae, from measurements of 300 plates taken with the 24-inch refractor. Her final result was 0.051 second of arc, corresponding to a distance of 64 light-years. The relative orbit is therefore somewhat larger than Saturn's.

Miss Lippincott calls attention to the possibility that stellar eclipses may occur in this nearly edge-on binary. She notes that F. Pavel's orbit calculation gave the inclination as 89 degrees 56 minutes, with an uncertainty of ±6 minutes, and comments:

"For eclipses to take place the inclination would have to be within 1′ of 90°. Assuming for the moment this to be the case, the next eclipse would occur very close to periastron lasting roughly two hours; the uncertainty of the parameters precludes a more accurate timing of smallest angular separation so that without continuous 24-hour observations for several days the occurrence or absence of an eclipse could not be established." According to Pavel's orbital elements, periastron takes place in mid-April, 1963.

ATLAS OF STAR CLUSTERS

Photographic charts of 70 galactic star clusters are reproduced in the latest *Publication* of the U. S. Naval Observatory, in which A. A. Hoag and his coworkers report on a very extensive program for measurement of magnitudes and colors of about 7,800 stars in these clusters.

Each chart is from a 30-minute exposure with the Naval Observatory's 40-inch reflector at Flagstaff, Arizona, and covers a field either one half or one quarter of a degree square. The photographic magnitude limit of the original plates is near 21. Accompanying each chart is an extensive catalogue of yellow magnitudes and color indexes of stars brighter than about magnitude 16. Star co-ordinates are given, making it easy to identify chart objects.

In each cluster field, brightnesses and colors of several dozen stars were first recorded photoelectrically, with either the 40-inch telescope or the 42-inch reflector of Lowell Observatory. Data for the remaining stars were then measured from photographs taken with the 40-inch. The probable error of a yellow magnitude is not far from ±0.01 for both the photoelectric and photographic work.

The purpose of the Naval Observatory program was to obtain color-magnitude arrays from which the distances and relative ages of the clusters can be deduced. The atlas should also be of value to amateurs who observe star clusters. It would be especially useful to anyone making a systematic study of the limiting star magnitude visible with various telescope apertures and magnifications.

UNNUMBERED MINOR PLANETS

Slightly fewer than 1,650 minor planets have received official numbers, signifying that their orbits are well enough known to permit locating these objects for several years into the future. But the total number of asteroid discoveries is much greater — several thousand were observed on a few occasions only and soon became lost. These minor planets have remained unnumbered, and are known by provisional names such as 1930 QQ.

A recent publication of Cincinnati Observatory contains the approximate orbital elements of some 2,500 unnumbered planets. For a minority of these, elliptical orbits are given, computed from three or more observations; the remainder are circular orbits from only two observations. This collection has been compiled from all available published data.

The special value of *Elements of Unnumbered Minor Planets* is that it aids in the identification of observations of the same planet made in widely separated years. For example, asteroid 1547, discovered in 1953 as 1953 QA, has turned out to be identical with 1929 CZ and 1940 PB. In such a case, the availability of older observations makes it possible to calculate a much more reliable orbit.

This 96-page publication has three sections. First is a listing of the orbital elements in chronological order of discovery of the asteroid, from 1891 to 1957. In the second, the orbital elements are listed in order of the numerical value of the ascending node's longitude. This makes it easy to check whether the elements of a newly discovered asteroid match those of some unnumbered one. Third, there is a table of all known or supposed identities of unnumbered planets with others.

LAYERED SURFACE OF THE MOON

A study of the radio emission from the moon by J. E. Gibson and his associates at the U. S. Naval Research Laboratory has led to some important conclusions regarding the lunar surface.

Measurements of lunar thermal radiation at wave lengths between 0.01 millimeter and 75 centimeters had shown there is no appreciable monthly variation in this emission at wave lengths longer than about four centimeters. Furthermore, no decrease in the moon's radiation is observable at wave lengths of more than about one centimeter when in eclipse.

The key to interpreting these facts is that the longer the wave length the farther below the moon's surface the radiation originates. Hence the variations in its intensity should indicate not only the physical properties of a surface layer, but also how these properties change with depth. As early as 1948, it was realized that the surface must be an excellent heat insulator, probably dust.

Measuring lunar radiation in the millimeter range is difficult, but many advances have been made in recent years. Dr. Gibson used a 10-foot parabolic dish to record lunar emission at 8.6 millimeters during the total eclipse of the moon on March 13, 1960. Special precautions had to be taken to allow for the appreciable extinction at this wave length by the earth's atmosphere. Within narrow limits, there was no eclipse-caused microwave dimming of the moon.

In an *Astrophysical Journal* article, Dr. Gibson presents his combination of these results with those of many other observers for several eclipses and for the monthly cycle of lunar radiation. He deduces that the surface of the moon is composed of three layers, the topmost being about half a centimeter in depth, and resembling ordinary sand. The intermediate layer may be several centimeters or more deep, and has high electrical conductivity. Beneath these lies a rocklike substratum of indefinite depth.

IN THE CURRENT JOURNALS

THE PROBING EYE, by H. C. King, *Spaceflight*, July, 1961. "Much of the history of the telescope, and incidentally, of the microscope also, is the record of a constant struggle to reduce . . . optical aberrations to within the limits necessary for good imagery. From Galileo's time until the mid-eighteenth century, however, the aberrations were but little understood and the refracting telescope had perforce to be developed along empirical lines."

STELLAR ECLIPSES AND STELLAR INTERIORS, by Alan H. Batten, *Journal* of the Royal Astronomical Society of Canada, June, 1961. "The distinction between eclipsing and spectroscopic binaries is largely artificial and could profitably be forgotten. It is only by a combined attack on all fronts that full understanding of individual binary systems may be won."

DUST HALO, by Fred L. Whipple, *Space World*, June, 1961. "Like Saturn, our earth seems to be a 'ringed planet.' Circling it are not only the well-known Van Allen Belts, but a newly discovered dust belt composed of micrometeoritic matter."

Astronomical Notes from Berkeley — I

U Geminorum Variable Stars

A striking hypothesis as to the origin of the U Geminorum variable stars was given at a session of IAU Commission 27 (Variable Stars) by Robert P. Kraft. These stars, of which over 100 are known, spend most of their time at minimum brightness, but at irregular intervals become several magnitudes brighter for a few days or weeks. The Palomar astronomer first summarized his extensive observations with the 200-inch reflector, using a prime-focus spectrograph of 180 angstroms-per-millimeter dispersion.

Dr. Kraft reported that at least four stars of this type were short-period spectroscopic binaries, in addition to SS Cygni, which was already known to be one. Thus the suspicion that all U Geminorum variables may be binaries is strengthened.

From their motions, Dr. Kraft deduces a preliminary value for the visual absolute magnitude of U Geminorum stars at minimum light as +9.5. Since the individual components of the binaries seem to have masses similar to the sun's, it follows that these stars are markedly underluminous for their masses — by four or five magnitudes.

He further pointed out many similarities of these binaries with the familiar W Ursae Majoris systems. In both cases, the primaries fill the inner lobes of their Lagrangian surfaces, and are subluminous. The motions of both classes of variables indicate that they are low-velocity stars, belonging to the disk population of the galaxy. From these and other points of resemblance, Dr. Kraft suggests that the two kinds of binaries are related, and that the U Geminorum systems may in fact be descendants of W Ursae Majoris stars.

Site Testing

Where should an observatory be built or a telescope erected to minimize the limitations caused by the earth's atmosphere? To study this problem, Subcommission 9b (Image Quality) formed a working group whose chairman was Jean Rösch, Pic du Midi Observatory.

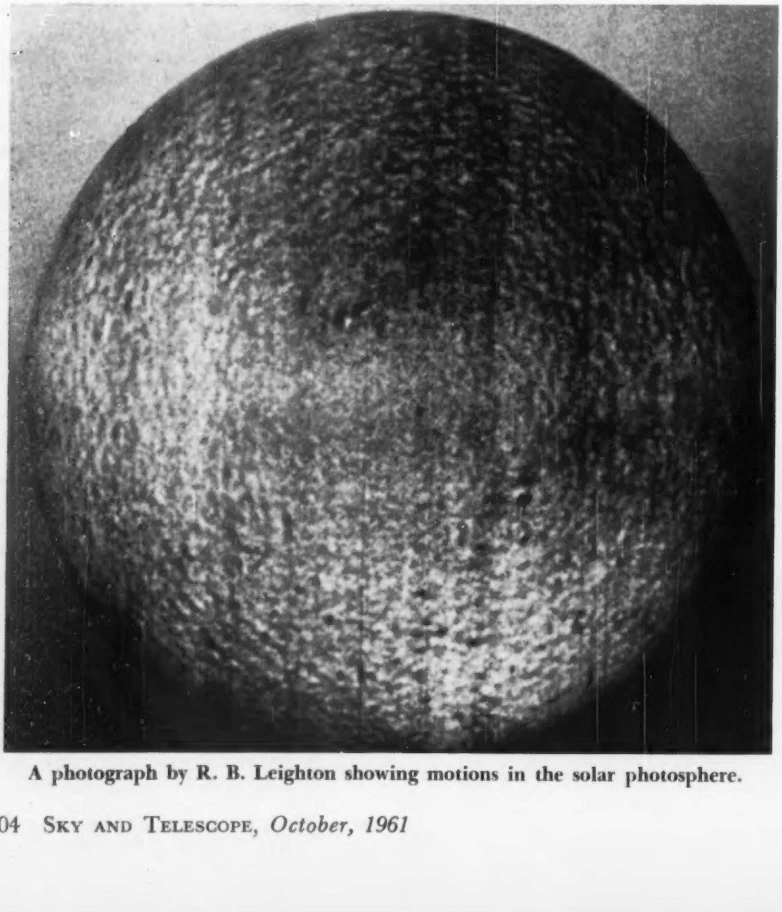
In his report, Dr. Rösch pointed out that the word *seeing* has been loosely used to cover very different aspects of image quality: sky transparency, atmospheric turbulence, image motion, the warping of extended fields, and scintillation. He proposed specific tests for these individual effects, and outlined a systematic program for site surveys.

I. S. Bowen, Mount Wilson and Palomar Observatories, emphasized to the subcommission that the causes of poor image quality are still incompletely understood. He stressed the need for more studies of the manner in which seeing depends on the temperature gradient in the atmosphere, on winds, and on the recently reported low-altitude jet streams. Even such questions as whether an observatory should be placed on the lee or windward side of a mountaintop are still controversial.

Seeing disturbances at high atmospheric levels will affect all types of telescopes: effects in the immediate vicinity of the ground or in an observatory dome are more serious for open-tube reflectors than for closed-tube instruments. At Cambridge, England, and at St. Michel, France, image quality has been improved by blowing air through the dome and down the telescope tube.

Dr. Bowen told of research on seeing conducted by his staff. Two telescopes are used to observe the same double star. They are placed so the light path from one stellar component to one telescope intersects the path from the other component to the other instrument at a chosen height in the earth's atmosphere. If the star images change in an identical manner, the seeing disturbance originates at that height. By varying the distance between the telescopes, different altitudes can be studied.

Other suggested approaches to research in image quality are: photographing the trails left by shaped charges shot at various altitudes; observations from balloons at different heights; setting up shock waves with a jet plane and observing their effect from the ground and the air; and simulating atmospheric effects in a wind tunnel containing an artificial star. It was noted that individual observers can greatly aid image study by recording how seeing varies with weather conditions.



A photograph by R. B. Leighton showing motions in the solar photosphere.

Solar Convection Cells

The picture of the sun reproduced here illustrates a method of studying line-of-sight motions in the solar photosphere. The photograph was obtained by R. B. Leighton, California Institute of Technology, using the 60-foot solar tower of Mount Wilson Observatory. He described the making and interpretation of such pictures to the IAU's Commission 12 (Solar Radiation).

Only a very narrow band of wave lengths was used, located inside but redward of the center of a strong absorption line in the solar spectrum. Hence, any Doppler displacement of the line, occasioned by a local motion of approach or recession, would cause a change in brightness of that immediate area. As a result, small differences in radial velocity are recorded as rather strong intensity variations over the photograph.

The darker areas indicate solar gases moving away from the observer, lighter areas approaching material. Dr. Leighton interprets his photographs as indicating that the photosphere has many large-scale cells of gas, in each of which the predominant motion is expansion parallel to the sun's surface. There are three principal reasons for this interpretation.

First, the central part of the solar disk

Between commission meetings, delegates stepped outdoors for a coffee break while they continued their discussions.

does not show any clearly defined light and dark areas (except in one active region above and left of center), indicating that there is little or no vertical or line-of-sight motion there. Second, in the intermediate regions between the center and the limb, where we view the photosphere obliquely, the light and dark areas are very prominent. We seem to be observing those components of the horizontal motion that are along our line of sight.

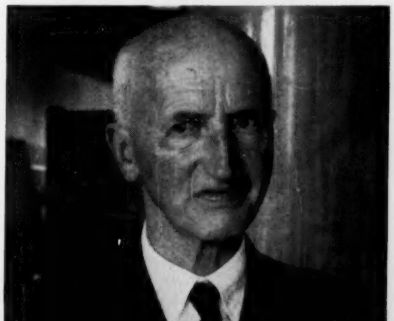
Third, the dark and light patches occur mostly in pairs, the dark component lying nearer the sun's limb. Each pair indicates an expanding cell, the near side having gases in motion toward us, while the far side recedes and appears dark.

The average diameter of these cells is about 15,000 kilometers (9,300 miles), and they have velocities of the order of half a kilometer per second. At any one time, there are about 5,000 of these local centers on the sun, with lifetimes of many hours. According to Dr. Leighton, the cells may constitute a "super-granulation" system of convection currents originating at considerable depths within the sun.

Evidence for Intergalactic Absorption

The probable existence of a vast obscuring cloud beyond the limits of our Milky Way galaxy was announced by Cuno Hoffmeister, of Sonneberg Observatory in East Germany, to Commission 28 (Extragalactic Nebulae). If this cloud is nearby – within the local group of galaxies – its dimensions are possibly comparable to those of the Magellanic Clouds.

Dr. Hoffmeister used the 10-inch Metcalf telescope of the Boyden Observatory in South Africa for six months in 1959, to search for RR Lyrae variables far from the plane of the Milky Way. As a check on the effects of interstellar absorption, he decided to study the distribution of exterior galaxies on his plates. About four months ago, while examining a region some two degrees north of Iota Microscopii, he discovered an irregular area of about 20 square degrees where there are only five galaxies instead of the expected 20 or 30. The RR Lyrae stars, however, are in normal abundance there, and are distributed quite at random.



Cuno Hoffmeister has announced discovery of an intergalactic cloud.

If there is indeed a cloud lying beyond the stars which are in our galaxy, and in front of the external systems, it should have less dense, diffuse outer parts. This would cause the galaxies in the center to be dimmed more than those nearer the edges. He counted galaxies in each of five concentric zones, centered on the obscuration, finding the following mean magnitudes and numbers for the galaxies in each zone, from the center outward: 15.75, 5; 14.97, 36; 14.85, 36; 14.69, 34; and 14.58, 106.

Another test would be to see if the individual galaxies have their elongated or extended (hence fainter) parts dimmed out first, the bright centers shining through the cloud but somewhat lessened in brightness. Using only 15th-magnitude objects, Dr. Hoffmeister made counts in each of his five zones, finding the following numbers of galaxies and the percentages of them that were elongated, starting at the center of the obscuration: 5, 0%; 25, 24%; 19, 31.6%; 22, 36.4%; and 46, 47.8%.

This evidence seems strong enough to indicate the presence of an intergalactic cloud beyond the halo of the Milky Way galaxy. Studies are being continued, particularly to determine the possible reddening of objects covered by the cloud. The obscuration appears to be dust, with no associated gas that might be detected by radio methods.

OBSERVING THE SATELLITES

Vostok II

THE most prolonged exposure to weightlessness ever endured by a human being was experienced by 26-year-old Gherman Stepanovich Titov when he made more than 17 circuits of the globe aboard Vostok II. For 24 hours and 59 minutes as he orbited the earth, both he and his spaceship "fell" at the same rate so that his body felt nearly free from any external forces. Despite this strange environment, Titov pursued a full day's activities with relatively little trouble.

According to unofficial press and radio reports, Vostok II was launched at 6:00 Universal time on August 6th from Baikonur, northeast of the Aral Sea in central Asia. During the launching the rocket trajectory was monitored and controlled by radio-guidance stations. After separation of the final stage of the rocket, the manned cabin weighed 10,430 pounds. It was estimated to be about 20 feet long and 13 feet in diameter.

The launching was announced after the first orbital revolution had been completed, and thereafter detailed reports were issued. Titov ate three meals while in orbit, and slept somewhat longer than scheduled. Apparently the weightlessness lessened his appetite and caused some unpleasant sensations originating in his inner ear, but these were largely remedied by avoiding sudden movements of his head, and were almost gone after he had slept.

While in orbit, Titov did exercises, made observations and recorded them in a flight log, signed autographs, took over manual control of the ship's orientation for long intervals, and carried on extensive radio communication with the ground.

The orbit of the spaceship was chosen to be below the Van Allen radiation belts, even though the vehicle was said to carry shielding. A favorable occasion of low solar activity was selected for launching, and during the flight ground stations watched the sun in order to anticipate any dangerous increase in solar particles. If the need had arisen, the spacecraft could have been brought down from orbit at any time.

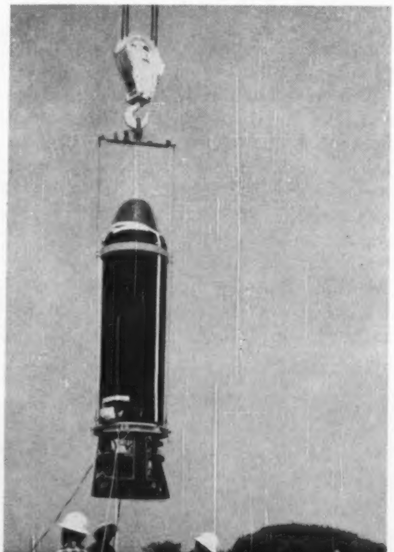
Soviet announcements confirmed that ships were stationed in the Atlantic and Pacific oceans as communication links with Vostok II. The spaceship carried a tracking beacon operated at 19.995 megacycles, and long-distance voice transmissions were made at 15.675 and 20.006 megacycles, using a common antenna with a diplexer. When over Russia, frequency-modulated signals at 143.625 ± 0.030 megacycles could be beamed at specific stations.

Two television systems were provided, with 100- and 400-line resolution, to permit a view of Titov's activities while he was in orbit. Inside his spacesuit there were telemetry transmitters monitoring the passenger's physiological responses.

Surely the most impressive feature of the Vostok II cabin was the life-support system that provided the kind of environment man needs for survival. The temperature was controlled by the pilot, and ranged between about 50° and 72° Fahrenheit; relative humidity stayed between 55 and 75 per cent. Air pressure was maintained at a level about five per cent greater than that of the normal atmosphere, with oxygen comprising 25 to 27 per cent. It was generated from superoxides aboard the spacecraft, a more advanced method than high-pressure containers of oxygen. Finally, the carbon dioxide level was held at 0.25 to 0.4 per cent. The equipment is said to have been sufficient for 10 days in orbit.

Within this artificial environment, Titov's pulse remained stable, his respiration normal, and his electrocardiogram showed no change.

Vostok II had three portholes, and through these Titov could view the earth in daylight; twice he glimpsed the waning crescent moon. He reported on the phenomena of passing into and out of the earth's shadow, and the prismatic effect at the horizon, where the atmosphere gradually shades into deep blue. As reentry began, while one of the portholes remained uncovered, he could watch the luminescence of the atmosphere caused by the spaceship's passage. Vostok II came down at Krasnykut, near Saratov.



The fourth stage of a Scout 5 rocket is here being hoisted to the top of the other three stages of the booster. Flown as Explorer XIII, this satellite was designed to measure micrometeorite sizes, energies, and numbers in the vicinity of the earth. The experiments are attached to the shell and nose cone of the fourth stage. All photographs courtesy National Aeronautics and Space Administration.

The Vostok II experiment was the seventh orbital launching in the Soviet biomedical satellite program, which began with Sputnik II in which the dog Laika lived for many days during November, 1957.

The orbit of Vostok II (1961τ1) was characterized by an 88.4-minute period, an inclination of 64.8 degrees, and a height above ground varying between 106 and 159 miles. The rocket's final stage, 1961τ2, with a very similar orbit, burned up in less than four days.

Short-Lived Explorer XIII

ASTRONOMERS and space engineers alike are interested in numbers, sizes, and motions of tiny particles of interplanetary matter. Recently, evidence has grown that the earth is surrounded by an extensive dust cloud (Sky and Telescope, February, 1961, page 71).

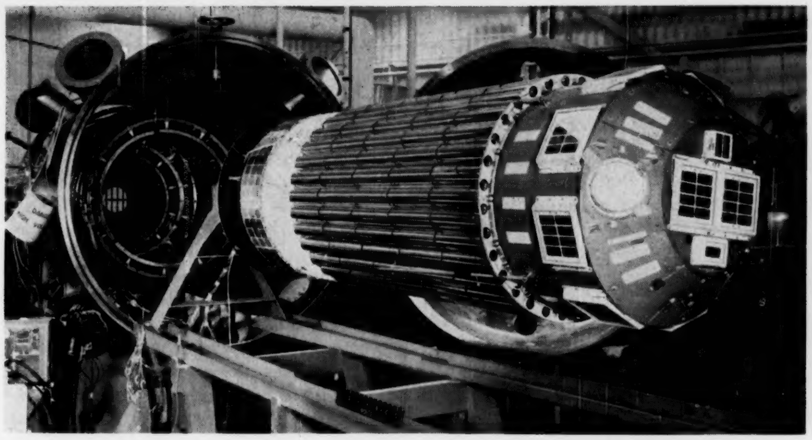
The space engineer is concerned with the possible effects of cosmic particles that may strike earth-orbiting vehicles at relative speeds up to 45 miles per second. Do they form a significant hazard to manned spacecraft or to the possibly thin-skinned orbiting space stations envisioned for the future? To answer such questions, an extensive series of experiments is being undertaken by the National Aeronautics and Space Administration.

Micrometeorite equipment was placed in the fourth stage of a Scout rocket sent up from Wallops Station, Virginia, on June 30th, but the third stage failed to ignite. This payload was duplicated for Explorer XIII, which took off from the Virginia coast at about 18:29 Universal time on August 25th.

The very short lifetime – only two days – of this satellite, 1961χ, indicates that the perigee distance must have been well under 100 miles. The orbital inclination has been given as 36.4 degrees. A total of 13 minutes of telemetry was received from the payload, but the usefulness of the data has not been announced.

Five major types of micrometeorite detectors were carried, in order to allow a comparison of different methods, some of which had been used in earlier satellites. For example, both Vanguard III and Explorer VIII had microphones to register impacts. Two calibrated microphones were aboard the 187-pound Explorer XIII.

Vanguard III had two pressurized sections, neither of which was punctured while telemetry was being received. An elaboration of this scheme was used in Explorer XIII, much of whose midsection



The micrometeorite satellite being put into a vacuum chamber at Langley Research Center for testing in a simulated space environment. For identification of some components, see the diagram below.

was covered with gas-filled "beer cans." Each was a small chamber, with a bellows switch to signal when a skin puncture released its nitrogen-helium charge. There were 160 of these half-cylinders, $7\frac{1}{4}$ inches long and two inches in diameter. Their arrangement was in five groups, each with a different thickness of beryllium-copper skin, ranging from 0.001 to 0.005 inch.

A new type of detector consisted of a sandwich of stainless-steel foil, mylar, and a printed electrically conducting circuit, designed to indicate punctures by electrical resistance changes. There were 60 of these triangular foil gauges, of two different sensitivities. Yet another system consisted of 46 rectangular plastic cards, closely wound with fine copper wire, whose breakage would cause a change in electrical resistance.

Finally, there were two light-sensitive detectors — cadmium sulfide cells mounted behind aluminized mylar screens within reflecting integrating spheres. Even very tiny punctures in a screen would admit enough light to be detected by the cadmium sulfide cells.

Together, all these detectors provided more than 28 square feet of sensitive surface, arranged compactly around a satellite only 76 inches long and 24 inches in diameter. Solar cells for power, and others for measurements of erosion, were also carried. Although the failure of Explorer XIII to attain its intended orbit prevented full use of this equipment, it indicates the nature of future payloads for investigating interplanetary dust and larger particles.

Far-Swinging Explorer XII

LAUNCHED on August 13th at 3:21 Universal time from Cape Canaveral, Explorer XII repeatedly traverses the Van Allen radiation belts of the earth. In purpose and in trajectory, the new satellite most closely resembles Explorer X, described in May (page 257). However, it has a longer-lived solar power supply, which is expected to extend measurements over many months, and its equipment is somewhat different.

The orbit of Explorer XII, 1961υ, is inclined about 33.04 degrees to the equator. The satellite reaches an apogee height of some 48,060 miles, while its perigee is only 183 miles above the earth's surface. The period is 26 hours 34 minutes, and the orbit is subject to important lunar perturbations.

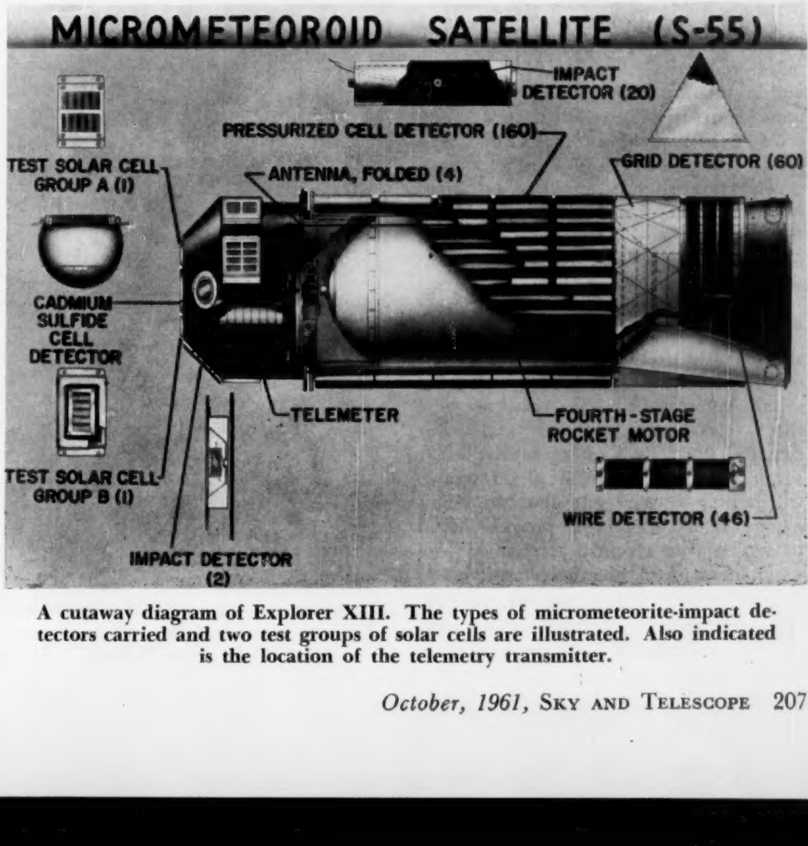
For some stations on earth, this satellite is above the horizon for almost 24 hours at a time, and enormous amounts of telemetered data have been received (at a frequency of 136.02 megacycles per second) by the three chief tracking stations: Santiago, Chile; Woomera, Australia; and Johannesburg, South Africa. For the first weeks several hundred large reels of magnetic tape were being recorded each day, but thereafter transmissions from Explorer XII were scheduled to be sampled when needed.

The instruments are designed for simultaneously detecting the elementary charged particles that move rapidly through the Van Allen region and the magnetic fields associated with them. Present-day theories of the motion of charged particles from the sun — the "solar wind" — and their effects on the interplanetary magnetic field rest upon very few observations. We also wish to reconcile many apparently anomalous facts concerning the terrestrial magnetic field at great distances.

Three fluxgate magnetometers, arranged for measurements along perpendicular axes, are used to determine field strength and direction. The sensors are carried on a boom some 32 inches away from the satellite body. The latter is a short octagonal column only $5\frac{1}{2}$ inches tall and about 26 inches across. Together with four solar-cell panels it weighs 83 pounds. There are 5,600 cells, and 13 silver-cadmium batteries to store the five watts they produce when fully illuminated.

Several types of equipment detect electrons and protons with energies ranging from a few up to 10 billion electron volts. There is a plasma proton analyzer which will measure direction and speed of protons moving between 200 and 2,000 kilometers per second. This apparatus consists of a pair of curved plates whose electrical potential may be varied, so that only protons that enter the device with the proper range of velocities will be collected by an electrometer.

A variety of Geiger counters, arranged to cover various segments of the energy spectrum, are provided to detect particles trapped in the Van Allen belts. Also, to permit electrons and protons to be identi-



A cutaway diagram of Explorer XIII. The types of micrometeorite-impact detectors carried and two test groups of solar cells are illustrated. Also indicated is the location of the telemetry transmitter.

fied independently, cadmium sulfide semiconductors will measure the total energy flux in several detector arrangements.

In order to obtain more information about the variation of cosmic rays with the 11-year solar cycle and with the Forbush phenomenon (a decrease in cosmic radiation after solar flares), several kinds of cosmic ray detectors, of different sensitivity levels, are used. One apparatus employs a series of absorbers, each of which is placed in turn before a photomultiplier tube.

Ranger I

ONLY a low orbit around Earth was achieved in the first shot of the Ranger program, instead of the intended translunar path (Sky and Telescope, August, 1961, page 82). Nevertheless, many important engineering test objectives were attained, though relatively little observational data could be expected.

The launching from Cape Canaveral, Florida, on August 23rd at 10:04 UT marked the first use by NASA of the Atlas-Agena B combination. Difficulties during countdown had caused four postponements of the firing, which finally had to await a favorable position of the moon.

Evidently the Agena B entered its parking orbit successfully, but failed to restart as planned. The Ranger spacecraft separated from the Agena, and these became artificial satellites 1961ϕ1 and 1961ϕ2, respectively.

The Ranger's system for attitude stabilization locked onto the sun as it was designed to do, and worked well during the sunlit part of each revolution. Also, telemetry performed well. Some information can be expected from the various cosmic ray and particle detectors aboard, but the magnetometer was too close to the earth for useful measurements.

While in orbit, 1961ϕ1's apogee and perigee heights were 306 and only 107 miles, respectively, period 91.0 minutes, and inclination 32.9 degrees. Almost the same figures apply to 1961ϕ2, the Agena stage of the launching rocket. But atmospheric drag affected this object more slowly, and it slightly outlived the Ranger in orbit, according to information released by the North American Air Defense Command. Ranger I stayed in orbit about seven days, the rocket 11.

The next Ranger shot, scheduled for later this year, will also be for testing equipment. Afterward, three launchings will be made to attempt to rough-land a seismometer on the moon. Although these three vehicles will also carry television cameras, fine-scale scrutiny of the lunar surface will await Rangers 6 through 9, which have just been authorized. This extension of the Ranger project should strengthen the recently accelerated program for manned lunar exploration.

MARSHALL MELIN
Research Station for Satellite Observation
P. O. Box 4, Cambridge 38, Mass.

Amateur Astronomers

The 27th Annual Stellafane Meeting

GOOD WEATHER and tender corn on the cob were enjoyed by 270 registrants at the Stellafane convention on August 12th in Springfield, Vermont. A well-planned program with practically clear skies for the night telescope evaluations made the occasion quite complete.

Mirror making for the lone amateur was the topic of afternoon talks by Ralph K. Dakin of Rochester, New York; Richard S. Luce, New York City; and John E. Welch, Springfield, Massachusetts. Skillful questioning by the session's monitor, Stanley W. Brower, owner of the Laboratory Optical Co. in Plainfield, New Jersey, probed the valuable experience of the speakers.

Maksutov enthusiasts gathered in numbers for their session under the direction of Alan Mackintosh, Glen Cove, New York. Exhibition of increasing numbers of this complicated instrument at Stellafane indicates continued improvement in the ability of amateur telescope makers.

Nine judges rated telescopes on mechanical excellence, giving a maximum of 40 points for stability, 15 for convenience of operation, and 45 for ingenuity in design. Diane and Jim Lucas of Elyria, Ohio, were awarded first prize for their 6-inch Cassegrainian Maksutov, which is pictured here. Since the reflector of R. H. Reniff, Ashland, Massachusetts, scored very close to the first-prize telescope, it was awarded a special citation for the best Newtonian telescope. Second, third, and fourth prizes went to Gaetan Sauvageau, Salem, Massachusetts (Newtonian); James A. Daley, Brookline, New Hampshire (Maksutov); and John McCarry, East Hartford, Connecticut (schiefspiegler). Among junior astronomers, the telescope prize was awarded to William Gabb, Jr., of Watervliet, New York.

This prize-winning f/2.3 Maksutov was built by Diane and Jim Lucas. Photograph by Jesse Wilson.

The twilight talks arranged and directed by Edgar Everhart, Mansfield Center, Connecticut, had universal appeal. Spiced with typical Vermont backwoods philosophy were the remarks by John C. Pierce, son of one of the founders of Stellafane.

Turning to astronomy, Walter Scott Houston, Middletown, Connecticut, discussed magnitude limits, fact and fancy, and George T. Keene of Eastman Kodak Co. presented several new techniques in color astrophotography. He showed lantern slides to demonstrate the new high-speed color films on which the planets can be recorded with exposures as short as half a second. An ordinary hand camera with an f/2 lens of two inches focal length is suitable for color pictures of the aurora; exposures may range from 10 to 60 seconds, depending on the motion and brightness of the display.

The photographic observation of variable stars was described by Henry Specht of New Haven, Connecticut.

Occasional fast-moving clouds did not hinder the night's observing or the optical-excellence telescope contest. Resolution, definition, and contrast were scored by eight judges, who imposed a handicap for professionally made optics. First prize was won by Fred F. Chellis, Manchester, Massachusetts, for a Newtonian, while second went to Kenneth E. Leathers of Manchester, New Hampshire, for his unobstructed, diaphragmed Newtonian. Edwin Root, Rochester, New York, was awarded third prize for his refractor, and the Lucas' Maksutov was fourth.

The next Stellafane meeting is scheduled for August 4, 1962.

JAMES W. GAGAN
17 Bellevue Ave.
Revere 51, Mass.

GEELONG, AUSTRALIA

Founded in September, 1960, the Gordon Astronomical Society now has 40 members. We are closely associated with the nearby Gordon Institute of Technology, which allows us the use of its 12-inch reflector for observing projects. Several amateurs in the society have formed a mirror-making group and discuss their problems at our monthly meetings, which are open to the public. We welcome correspondence with other more experienced amateurs throughout the world.

P. F. CULLEN
P. O. Box 209
Geelong, Victoria, Australia

+++ Amateur Briefs +++

The Skyscrapers of North Scituate, Rhode Island, invite amateurs in the New England area to an astro-assembly on Saturday, October 7th, at 3 p.m. The program, to be held at the society's observatory on Peeptoad Road, will include a telescope and accessory contest. For more information contact Mrs. Mary U. Marsh, 56 Progress St., Lincoln, R. I.

San Diego's first public star party was sponsored in mid-September by the San Diego Astronomical Society and the local state college's astronomy department. Hand and machine mirror grinding and various types of optical systems were on exhibit, and the film Universe was shown.

Tommy Henningsson, a 17-year-old amateur astronomer in Sweden, would like to correspond with an American amateur. He has a 2½-inch refractor and belongs to the Swedish Astronomical Society; his address is Hasslarod 531, Osby, Skane, Sweden.

A British astronomer enjoying one of the IAU field trips to Lick Observatory commented that picnicking in the shadow of the 36-inch refractor's dome was akin to "eating fish and chips in St. Paul's cathedral."

Five or six years ago several amateurs with large telescopes set up an "Inner Sanctum" of amateur variable star observers. A sanctum star is one whose maximum brightness is less than or equal to magnitude 14.0, so notes on all variables estimated at 13.8 or fainter are circulated and compared. Anyone interested in joining the group should get in touch with Thomas Cragg, 246 W. Beach Ave., Inglewood 3, Calif. G. B. C.

BOISE, IDAHO

Six adults and nine teenagers from Boise and Nampa, Idaho, met on July 22nd to organize the Boise Valley Astronomical Association. Their activities include formal monthly meetings and an observational program.

Amateurs interested in the club should write Miss Teddie Hardy, 120 Horizon Dr., Boise, Idaho.

Members of the Memphis Astronomical Society survey their exhibit in the city's museum. The display was featured in a special article in the Memphis "Commercial Appeal," which included this photograph by Wayne Tilson.

TENNESSEE AMATEURS PRODUCE ASTRONOMICAL EXHIBIT

Wide public attention has been drawn by the Memphis Astronomical Society's prominently placed display in the city's museum. Financed by the club, the project was set up by three members, J. C. Flippin, S. A. McBroom, and A. C. Emery.

The exhibit contains a 6-inch reflector telescope, cut away so that even the components of the eyepiece are visible. In addition, there are mirror grinding materials, a pitch lap, a partially parabolized 6-inch mirror, and a standard selection of eyepieces.

GEORGE P. TURNER
3713 Wilshire Rd.
Memphis 11, Tenn.

QUESTIONS... FROM THE S+T MAILBAG

Q. Which constellations contain the most naked-eye stars?

A. Both Centaurus and Cygnus have about 150 stars brighter than magnitude 6.0, while Puppis and Hercules have about 140 each.

Q. In what constellation would our sun be, as seen from Alpha Centauri?

A. The sun would be a 1st-magnitude star in Cassiopeia, east of the "W."

Q. What is the focal ratio of a Schmidt camera of 24 inches focal length, with a correcting plate of 8-inch diameter and a 12-inch mirror?

A. It is f/3, the f-number being obtained by dividing the focal length by the correcting-plate clear diameter, not the mirror diameter.

Q. What is a prismatic astrolabe?

A. This device consists of a small horizontal telescope, with a 60-degree prism in front of the objective and a mercury basin beneath it. A star seen through this instrument has two images, one ascending, the other descending as the star's altitude changes. The moment they meet gives the time when the star has a definite altitude, which is constant for the instrument. A. Danjon of Paris Observatory has recently made great refinements in the prismatic astrolabe, so that it can serve for very precise determinations of latitude, time, and star positions.

W. E. S.

THIS MONTH'S PROGRAMS AND CONVENTIONS

Cambridge, Mass.: American Association of Variable Star Observers. Harvard Observatory, October 12-15.

New Orleans, La.: Pontchartrain Astronomy Society, 8 p.m., Louisiana State University science building. October 6, Dr. Bill J. Good, Louisiana State University, "Electromagnetic Spectrum, Part 2, Laboratory Demonstrations."

New York, N. Y.: Amateur Astronomers Association, 8 p.m., American Museum of Natural History. October 4, Raymond N. Watts, Jr., Sky and Telescope, "The Most Interesting Star in the Sky."

New York, N. Y.: Junior Astronomy Club, 8 p.m., Waverly Building, New York University. October 20, Dr. Robert E. Danielson, Princeton University Observatory, "The Surface of the Sun."

Pittsburgh, Pa.: Amateur Astronomers Association of Pittsburgh, Allegheny Observatory. October 13, Wallace Beardsley, Allegheny Observatory, "Star Classifications Based upon the Spectrograph."

Shreveport, La.: Shreveport Junior Astronomical Society, 7:30 p.m., Centenary College science hall. October 21, Hon. Overton Brooks, U. S. House of Representatives, "This Space Age."

Washington, D. C.: National Capital Astronomers, 8:15 p.m., Commerce Department auditorium. October 7, Robert J. Hackman, U. S. Geological Survey, "Photo Interpretation of the Moon's Surface."

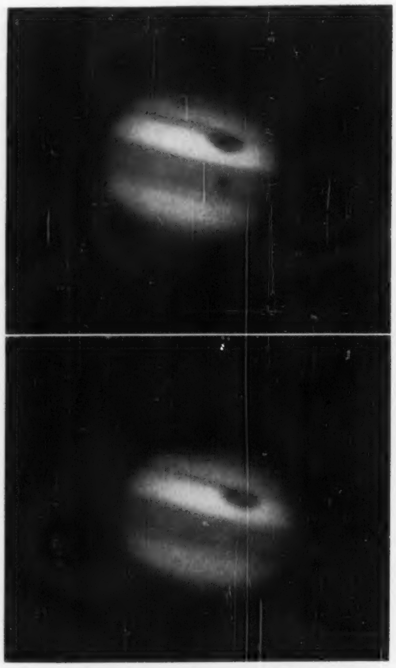
OBSERVER'S PAGE

Universal time (UT) is used unless otherwise noted.

JUPITER'S RED SPOT

SINCE early this June the famous red spot on Jupiter has been under observation by the Planetary Astrophysics Office of New Mexico State University, under the direction of Clyde W. Tombaugh. This important feature of Jupiter's southern hemisphere is now staging one of its irregular appearances, and has become quite prominent even in instruments of modest size. Visual observations have been made with reflectors of 8-, 9-, 12-, and 16-inch aperture, and photographs were taken at the 66-foot Cassegrainian focus of a 12-inch Fecker reflector.

Almost all properties of the red spot — its rotational period, size, shape, color, position, and surroundings — are more or less variable (see May issue, page 272). To facilitate observation, the author has compiled an ephemeris (begun last month in this department) of the times when the feature will cross Jupiter's central meridian. The ephemeris is based upon an assumed sidereal period for the red spot of $9^h\ 55^m\ 42^s.7$ ($0^d.41369$), which is an average of its period over the last three decades, and a transit at $6^h\ 20^m$ Universal time on July 1, 1961, as determined from a blue photographic plate. From this observation, the marking's longitude (System II) was found to be 2°.8.



Jupiter's great red spot is the dark oval just to the right of the central meridian; below it is the shadow of the satellite Io. These enlargements are from a series of 63 images on an Eastman IV-O plate, taken August 8, 1961, at the f/66 Cassegrainian focus of a 12-inch reflector. Exposure times were three seconds each. Clyde W. Tombaugh comments: "The red spot is a marvelous sight in my 16-inch when the seeing is 6 or better. The pink color is as vivid as I have ever seen it." New Mexico State University photographs.

In preparing these predictions, due allowance has been made for the changing direction of the earth as seen from Jupiter, and for the varying time required for Jupiter's light to travel to us. The table lists predicted Universal times, rounded to the nearest 0.1 hour, of the spot's passage across the central meridian of the planet's disk. Because the rotation period is not constant, there may be small dis-ephemeris is nearly nine seconds longer. served times.

Ever since systematic observations of the red spot began in the late 19th century, there has been a gradual lengthening in its rotation period. The values vary somewhat erratically from year to year, but the general trend is quite clear. The average period in 1879-80 was $9^h\ 55^m\ 34^s$, while that adopted for the author's ephemeris is nearly nine seconds longer. This month, with Jupiter in a convenient position for viewing, as many observers as possible should time central-meridian transits of the red spot. Such observations would be of great value for an accurate determination of its present rotational rate.

In general, the red spot is an elliptical configuration, with its major axis roughly parallel to the Jovian equator. Its dimensions are of the order of 25,000 by 8,000 miles, but are subject to considerable change. The average extent in longitude from 1879 to 1882 was 33°.7. In 1919 and 1920 the ends of the spot were drawn out to points more than 40° apart. In 1935 it was 30° long, in 1936 only 21°. At present, its longitudinal extent is 23°, as indicated by our visual and photographic observations. The north-south dimension usually averages about 10°, but now covers 14° of latitude on photographs taken in blue light.

During the years when it is faintly visible, the red spot appears as a gray stain on the planet's surface. Ordinarily, however, it exhibits a reddish color, although its hue has varied a good deal. Early pictures of the spot are colored a deep red, but in 1886-87 it was described as having a "pinkish tinge," while in 1909-10 E. M. Antoniadi said it was "intensely pink." In recent years the spot has appeared most commonly as an elongated ring, with the central region much fainter than the periphery.

Visual observations by Dr. Tombaugh indicate that the present form of the spot is a variation of the ring structure. The

large central portion has a fairly uniform deep pink color, but along the southern edge there seems to be a rather dark shell. At the following end of the spot, this shell trails out into a knot or tail, making the ellipse somewhat unsymmetrical and causing difficulty in transit timings. Toward the northern edge the pink color seems to fade out, but this could be a subjective effect due to the very bright area north of the spot.

The red spot's latitude also undergoes erratic variations. Filar micrometer measurements by G. W. Hough from 1879 to 1882 gave a mean zenographical latitude of $-24°.4$. (Zenographical latitude on Jupiter is analogous to geographical latitude on Earth.) Observations by Rev. T. E. R. Phillips from 1908 to 1930 averaged $-21°.8$, while plate measurements at the present apparition yield $-22°.5$. On a few brief occasions, the spot's major axis has been observed to have a considerable inclination to the planet's equator. In all such cases, the preceding end of the spot has had the larger latitude.

We would expect from the latitude of the red spot that it should overlap the southern edge of the South Equatorial Belt, but this does not occur. On the occasions when the south component of the South Equatorial Belt and the spot are observed simultaneously, there is a semi-elliptical depression in the belt, and there is always some distance between it and the spot. Known as the *red spot hollow*, this feature of the South Equatorial Belt is usually visible even when the spot is not, thus giving a constant check on the spot's longitude. Sometimes, particularly when the spot is faint, the ends of the hollow arch around the spot, occasionally joining to form a dusky ring. At present, and during most apparitions of recent years, the red spot hollow has not been visible, because of the faintness of the entire south component of the South Equatorial Belt.

The southern edge of the red spot often reaches the latitude of the north edge of the South Temperate Belt, but a "hollow" is seldom observed there. The spot merely overlaps and blends with the belt, although during a few apparitions the South Temperate Belt has been displaced slightly southward. At present the spot makes a small incursion into the belt's latitude and on blue photographs looks considerably darker than the belt.

Of the pictures thus far taken by our New Mexico group, the red spot is visible only in those exposed in blue and violet light, on Eastman IV-O plates without filters. A few exposures in red light have been made on IV-E plates through a Schott OG-2 filter, but this combination does not give enough contrast to show the spot.

As yet, no fully satisfactory explanation of the physical nature of the red spot and its varied behavior has been given. A discussion of some hypotheses can be found in *The Planet Jupiter* by Bertrand M. Peek (Macmillan, 1958), from which much of the historical information in this article has come.

CHRISTOPHER M. ANDERSON
New Mexico State University
University Park, N. M.

RED SPOT MERIDIAN TRANSITS

October 1, 2.3, 12.3, 22.2; **2,** 8.1, 18.1; **3,** 4.0, 13.9, 23.8; **4,** 9.8, 19.7; **5,** 5.6, 15.6; **6,** 1.5, 11.4, 21.4; **7,** 7.3, 17.2; **8,** 3.2, 13.1, 23.0; **9,** 8.9, 18.9; **10,** 4.8, 14.7.

11, 0.6, 10.6, 20.5; **12,** 6.4, 16.4; **13,** 2.3, 12.2, 22.2; **14,** 8.1, 18.0; **15,** 3.9, 13.9, 23.8; **16,** 9.8, 19.7; **17,** 5.6, 15.5; **18,** 1.5, 11.4, 21.3; **19,** 7.2, 17.2; **20,** 3.1, 13.0, 23.0.

21, 8.9, 18.8; **22,** 4.8, 14.7; **23,** 0.6, 10.6, 20.5; **24,** 6.4, 16.4; **25,** 2.3, 12.2, 22.1; **26,** 8.1, 18.0; **27,** 3.9, 13.9, 23.8; **28,** 9.7, 19.6; **29,** 5.6, 15.6; **30,** 1.4, 11.4, 21.3; **31,** 7.2, 17.2.

ED. NOTE: These Universal times are for transit of the *middle* of the red spot across the central meridian. The spot's full length takes roughly three quarters of an hour to pass. This ephemeris gives times only to the nearest 0.1 hour, to help observers avoid bias, but their estimates of spot transits are to be recorded to the nearest minute. If possible, transit times should be obtained not only for the middle of the spot but also for its preceding and following ends. Observations should be reported to the Jupiter recorder of the Association of Lunar and Planetary Observers, Philip R. Glaser, 400 E. Park Ave., Menomonee Falls, Wis.

Notes on Comet Wilson

COMET 1961d has been fading steadily as it recedes from both the earth and sun. Photographs taken up to mid-August show the long and straight tail that was characteristic just after discovery. By the first week in October, the comet will be over 100 million miles from the earth, with an expected magnitude of about 11, but possibly considerably fainter. Despite the increasing number of positional measurements, as late as Labor Day the comet's orbit was still quite uncertain.

Using observations through August 2nd, M. P. Candy of the British Astronomical Association computed a new orbit, which places the comet on August 19th some eight degrees from the corresponding prediction of his first orbit. His new elements show that 1961d passed through its perihelion on July 17th, at a distance of 0.0395 astronomical unit (3.7 million miles) from the sun.

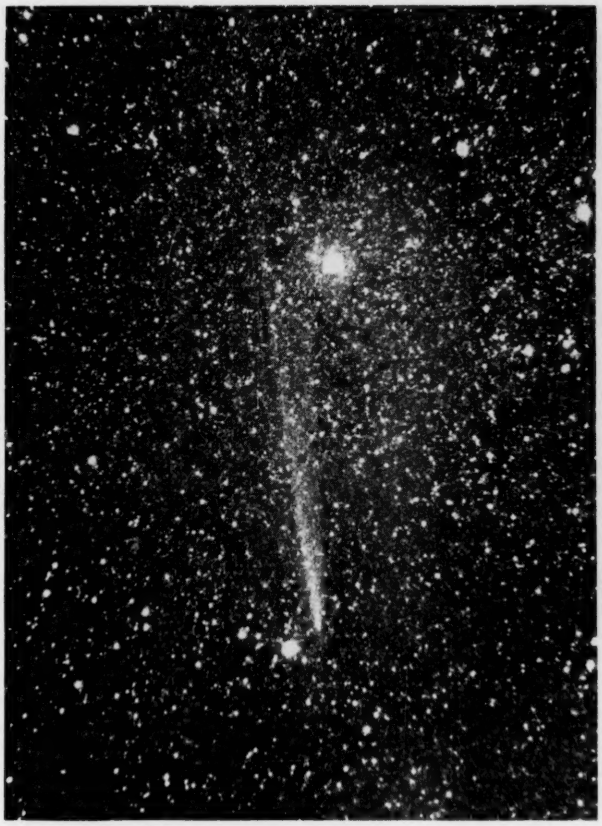
A hyperbolic orbit with the surprisingly large eccentricity of 1.0046 was derived by Z. Sekanina of Prague, Czechoslovakia. This calculation also yielded a very small perihelion distance — 0.0079 astronomical unit — only slightly larger than the record of 0.0055 set by the great comets 1843 I and 1880 I. However, the Sekanina orbit is only preliminary, and further study is needed.

Usually there are many independent discoveries of a bright naked-eye comet like 1961d, making priority difficult to establish, and lessening its importance. Dr. W. S. Finsen, of the Republic Observatory in Johannesburg, South Africa, reports that Comet 1961d had been spotted some nine hours prior to A. Stewart Wilson's discovery, hitherto the earliest known. A South Africa Airways hostess, Miss Anna Ras, saw it at 2:39 Universal time on July 23rd. Her plane was flying at 36,000 feet over Libya, near the Egyptian border, when she called the crew's attention to the comet, then about 15 degrees above the horizon, with a nearly vertical tail extending to an altitude of 30°

Readers of Sky and Telescope have sent in a number of pictures and observational reports in addition to those on pages 123-126 of last month's issue. On August 2nd and again on the 4th, David Coffeen of Boulder, Colorado, used an 8-inch Schmidt camera belonging to the University of Colorado's physics department to record Comet Wilson.

Two amateurs from North Hollywood, California, photographed 1961d on the morning of August 6th. At 11:15 UT Tom Thorpe made a 10-minute exposure and at 11:30 Kent De Groff took the picture on the next page, both using an f/1.9 lens on a 35-mm. camera loaded with Eastman XX film. Mr. De Groff reported that the comet was barely visible to the unaided eye, but his negative exposed for five minutes showed a tail about 12 degrees long.

Paul Knauth, president of the Lamar



Comet Wilson, photographed by Kent De Groff on August 6th (left) and by Paul Knauth and William Hubbard three days later. Notice the comet's drift among the stars during that time. Although the scale of the two pictures is not quite the same, they show the decrease in tail length and brightness. In both cases, Capella is the bright star slightly above center; Beta Aurigae is near the bottom. North is toward the left.

Astronomy Club of Houston, Texas, sent the second picture of the pair reproduced above. He and William Hubbard took it on August 9th with a 35-mm. camera attached to the tube of the McDonald Observatory's 10-inch Cooke refractor.

Dennis Milon, who also observed from McDonald Observatory on Mount Locke, saw the comet on the 9th and 10th as an object of magnitude 6½ or 7, with a four-degree tail. He also photographed it on August 13th, finding the tail eight degrees long on his negative.

A fine series of pictures, taken by R. B. Minton in El Paso, Texas, runs from July 26th to August 7th, and shows the comet's decrease in brightness as it moved across Auriga. Mr. Minton, who is a member of the Orion Society of El Paso, could see a 45-degree tail on the first morning, despite the light of dawn.

In October, Comet 1961d will move from western Andromeda to near the Pegasus-Cygnus boundary. The following predicted positions are from Mr. Candy's ephemeris in *Circular* 1767 of the International Astronomical Union. For 0^h UT on every fifth day are given the comet's right ascension and declination (1950 coordinates):

September 28, $23^h\ 35^m.3$, $+47°\ 54'$. October 3, $23^h\ 18^m.7$, $+44°\ 33'$; 8, $23^h\ 06^m.3$, $+41°\ 22'$; 13, $22^h\ 57^m.2$, $+38°\ 24'$; 18, $22^h\ 50^m.7$, $+35°\ 42'$; 23, $22^h\ 46^m.3$, $+33°\ 17'$; 28, $22^h\ 43^m.4$, $+31°\ 07'$.

This ephemeris is uncertain. The Sekanina orbit places the comet $13^m.0$ east and 46′ north of Candy's position on September 28th, and $11^m.3$ east and 2° 28′ north on October 28th. Both calculators predict the comet will be about magnitude 12½ or 13 at the end of October, but some observations suggest it may be fading even more rapidly.

OBSERVATIONS OF DELTA LIBRAE

A description of the Algol-type variable star Delta Librae was given on page 302 of the May issue. Marvin E. Baldwin, of Holloman Air Force Base, New Mexico, has sent in a long list of magnitude estimates of this star, obtained on five nights between June 8 and July 19, 1961, with the aid of 7 x 50 binoculars. From these observations he has determined five times of minimum light, which are given below as Julian dates with the heliocentric correction included. Here n is the number of estimates secured during each minimum.

Julian Day	n	E	$O-C$
2437458.832	17	+1,290	$+0^d.009$
472.791	21	+1,296	+0.003
479.772	15	+1,299	+0.002
486.744	17	+1,302	−0.009
500.723	15	+1,308	+0.005

These observed times may be compared with the prediction formula $m = 2434456.5426 + 2^d.327353E$ in the Moscow *General Catalogue of Variable Stars* (1958), in which E is the whole number of cycles elapsed since the initial epoch of minimum. The difference, $O - C$, of the observed minus the computed time of minimum is given in the fourth column.

The fourth and fifth minima are less reliable, since for the former there were too few estimates after midminimum, and in the latter case the observations extended over only three hours. Giving these determinations half weight, the average residual is $O - C = +0.003$ day. In other words, during the summer of 1961 the minima of Delta Librae were occurring only about four minutes later than predicted.

DEEP-SKY WONDERS

THIS MONTH we continue the listing begun in September of some celestial objects to be found by the star-drift method. The telescope is armed with a low-power eyepiece of 1° field, and is pointed at a star west of the object sought, but at the same declination. The instrument is then left untouched for

a time interval corresponding to the difference in right ascension, at the end of which the desired nebula or cluster will be in the field of view. Our subjects are three globular clusters and a spiral galaxy.

Just past the meridian these fall evenings is Delphinus. Set your telescope on Gamma Delphini, and 15 minutes later the globular NGC 7006 will be in view. Though readily detectable in a 3-inch instrument, it is small – 1.1 minutes of arc in diameter – and so concentrated that it may at first be mistaken for a 10th-magnitude star. Its 1950 right ascension and declination are $20^h\ 59^m.1$, $+16°\ 00'$.

M30 (NGC 7099) is a second globular cluster, at $21^h\ 37^m.5$, $-23°\ 25'$. Place Zeta Capricorni at the northern edge of the field of view, and 14 minutes later the cluster will be close to the southern boundary. Of visual magnitude $8\frac{1}{2}$, this massing of stars is $5'.7$ across and "pearl white" in color. An interesting experiment is estimating its magnitude by racking the images of nearby stars out of focus until they are the same apparent size as the cluster.

Next on the list is NGC 7479, a barred spiral in Pegasus at $23^h\ 02^m.4$, $+12°\ 03'$. Set on Xi Pegasi and wait 18 minutes for this object. If your eye is properly dark-adapted, the galaxy should be visible in even a 3-inch telescope, but a 6-inch is better. A cloth over your head and the eyepiece gives good protection from stray light. Of about 11th magnitude, NGC 7479 shows an elliptical disk $3'$ by $2'.5$, about three times the apparent diameter of Jupiter.

The final object is NGC 7492, a globular 14 minutes wait east of Delta Aquarii; it will come into the field north of center. Located at $23^h\ 05^m.7$, $-15°\ 54'$, its size is $3'.3$ and the apparent concentration of stars is not very great. The magnitude is about 11, but published values clash badly.

WALTER SCOTT HOUSTON
36 Lawn Ave.
Middletown, Conn.

AUGUST AURORAS

THREE auroral displays were reported during August, one seen from points some 500 miles apart. On the night of August 2-3, quiet arcs and a faint glow were observed from Madison, Wisconsin, by George W. Rippen, the center of the display being far to his north.

Much more prominent northern lights were seen by Mr. Rippen between 2:30 and 4:30 UT on August 11th. Most of the time this aurora consisted of a quiet homogeneous arc of medium intensity, lying between 16° and 23° above the horizon. At maximum, however, a faint rayed arc reached 30° altitude.

This same aurora was observed and photographed in Canada by Tim Hunter of Arlington Heights, Illinois. At 3:10 UT a white band 10° wide stretched across the sky from Ursa Major through Andromeda. At times rippling like a curtain, it was almost bright enough to blot out Cassiopeia. Extending from the band to the zenith were long, thin rays.

Far south in Tulsa, Oklahoma, a third aurora was seen by Louis Desjardins from 2:00 to 4:00 UT on August 24th. The first part of the display spread from the northeast horizon across the north and west between about 5° and 45° elevation; after 15 minutes it shrank to a narrow arch and disappeared. The reddish second part spread from the north to the southwest, again narrowing to an arch that became brighter near the end of the event. Irregular red patches rose from it, filled half the sky, and finally gathered into a fading arch in the south.

AN AMATEUR'S SKY ATLAS

The sky as seen from New Orleans has been systematically photographed during the last 15 months, and now 77 glossy prints comprise my sky atlas to declination −55°.

Each photograph was exposed about four minutes in my Yashica reflex camera at f/3.5, moved by a clock drive that I constructed from a washing-machine timer. The richer areas of the sky are pictured down to magnitude $8\frac{3}{4}$.

The 8-by-8-inch prints are filed in a ring binder in order of right ascension, and subfiled by decreasing declination.

WILLIAM P. SEARCY, III
1916 Fern St.
New Orleans, La.

The northern lights at about 10:15 p.m. EST on August 10th, photographed by Tim Hunter, 40 miles north of Nipigon, Canada. He pointed his 35-mm. Argus camera toward Alpha Andromedae for a one-minute exposure at f/4.5 on Tri-X film. The display was near its height at the time.

Observations of the Perseids in August

LARGE NUMBERS of amateurs, many in groups, went to their favorite observing sites and spent long hours watching the Perseid meteor display in the middle of August. They had mostly clear skies and the counts ran high. During maximum on the night of August 11-12, as many as 60 meteors were seen by a single observer in one hour, agreeing with predicted rates.

August 8-9. Only Rodney Norden, Norfolk, Virginia, and Gordon Solberg, Las Cruces, New Mexico, reported for this night. Of the 12 meteors seen in two hours by Mr. Norden, three were of 1st magnitude, one leaving a blue-white train three degrees long and lasting for five seconds. Mr. Solberg saw a deep yellow fireball of magnitude —4.5, at 7:54 Universal time on August 9th; it left a gray train visible for 30 seconds in binoculars.

August 9-10. Michael McCants and Paul Knauth, of the Lamar Astronomy Club in Houston, Texas, saw 135 meteors in a $2\frac{1}{4}$-hour period, starting at about 2:05 a.m. Central standard time. These amateurs also observed on the next three nights, being joined by Dennis Milon on a meteor observing excursion to McDonald Observatory. Mr. Knauth writes, "Our observations were hampered by frequent invasions of skunks, deer, bats, and porcupines. Also, the zodiacal light was very bright." They stayed with William Hubbard, one of the discoverers of Comet Wilson 1961d.

Mr. Solberg observed on this date also, his total for two mornings being 173 meteors, most between magnitudes 2 and 4, with some 1st magnitude and brighter.

August 10-11. The Lamar group, with two or three observers working four hour-long recording periods, amassed more than 360 meteors, of which about 100 were not Perseids. Out on the desert near Las Vegas, Nevada, Elliott Bold watched for $5\frac{1}{2}$ hours, from 10 p.m. to 3:30 a.m. Pacific standard time, counting 58 meteors, many of them 1st magnitude or brighter. Mr. Norden also observed that night for $1\frac{1}{4}$ hours, counting 16 meteors.

August 11-12. Working through the night, two observers at a time, with some interruptions, the Lamar group at McDonald Observatory recorded more than 570 meteors, about one-fifth of them sporadic rather than Perseids. Mr. Bold watched for two hours, plotting 46 meteors to find their paths fanning outward from north of Alpha Persei.

In a dusk-to-dawn vigil at Charlton Flats, about five miles from Mount Wilson, Lewis Chilton of Los Angeles saw 165 meteors. The top of an automobile provided a convenient prone observing position, but he had to get up and walk around to keep from falling asleep. On color film he captured good star images, but it chanced that the two meteors recorded were white.

Another all-night observer was Glenn E. White, from his backyard patio in Shreveport, Louisiana. Beginning with only 12 meteors in the first two hours, the numbers increased until there were 45 per hour by the time he retired at 4 o'clock in the morning. From Dallas, Texas, David Bradbury reports observations by juniors of the Texas Astronomical Society; from 3:10 to 3:40 a.m. CST, three persons saw a total of 81 meteors.

At Thomaston, Connecticut, J. Hannon and T. Nicholls used lawn chairs with reclining backs and watched for about $6\frac{1}{2}$ hours, for a total of 162 meteors, the highest rate being reached not long after midnight. At nearby New Britain, Lawrence Kratka made counts that increased from 30 per hour, beginning at 8:45 p.m. EST, to 63 per hour ending at 1:45 a.m.

At Marshville, North Carolina, four red meteors brighter than magnitude zero and a bluish-white object nearly as bright as Jupiter were seen by Vic Lowery and Ronnie Witmore, who counted 107 meteors from 11 p.m. to 3 a.m. From Kalamazoo, Michigan, Rudolph Light's maximum counts were above 40 per hour, in the morning hours. At Madison, Wisconsin, members of the Junior Astronomical Society worked together, four observers seeing a total of 272 meteors in a three-hour period at the height of the shower.

Weather was perfect near Handsboro, Mississippi, for photographic and visual work by James Defibaugh and E. J. Serpas, who observed from midnight to 4:30 a.m. CST, their highest individual hourly rate being 43.

August 12-13. A few of the Madison juniors also observed on this date, but few meteors were seen compared with the previous night, according to Fred Kludy. Two more observers joined the pair at Thomaston and averaged a total of 59 meteors per hour for nearly six hours of observing; from 2 a.m. to 3 a.m. their total was 88, indicating that the shower was still strong. In fact, in this same hour four members of the Denver Astronomical Society logged 111 separate meteors, and another four counted 42. This team of eight members observed at a 9,000-foot campsite in the Colorado mountains.

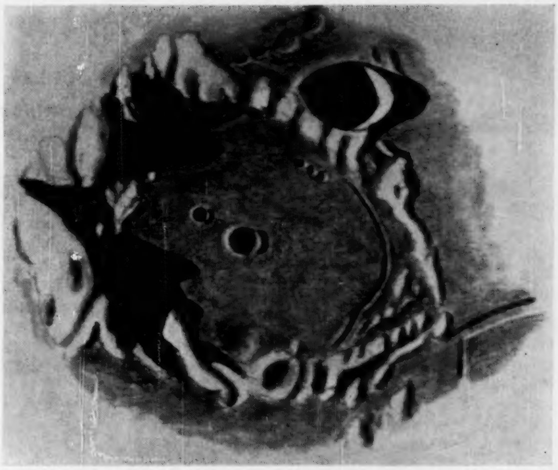
After attending the Stellafane convention, David Hoffman observed the Perseids from Chester, Vermont. This amateur from St. James, New York, noted intermittent, brief, hazy explosions of light with an estimated magnitude of 4. These unexplained flashes appeared more frequently than the meteors and even when no meteor had passed, and their numbers did not increase with the Perseids as the evening progressed.

August 13-14. Data on 153 meteors were recorded during a $7\frac{1}{2}$-hour vigil by five members of the Blue Ridge Astronomy Association at Luzerne, Pennsylvania. In the early morning hours they listed over 40 meteors per hour.

Observing the Moon — Hesiodus

NEAR the southwestern border of Mare Nubium, Hesiodus forms a conspicuous crater pair with its larger western neighbor, Pitatus. The diameter of Hesiodus is 27 miles, according to J. Young's catalogue, and my own measures agree well with this value.

Like other craters located near the edges of lunar maria, its walls are much eroded on the seaward side. The highest portions of the rim are on the west, where the mutual wall with Pitatus attains elevations of 2,600 feet or more, from my measurements. This wall is interrupted by a pass that joins the floors of the two craters. Wide on the Hesiodus side, the opening quickly shrinks to a narrow defile before entering Pitatus.



Alika K. Herring made this drawing of the lunar crater Hesiodus with his 12½-inch reflector, 278x, on May 24, 1961, at 4:35 Universal time. In both views on this page, south is upward, east to the right. The conspicuous shadow-filled crater near the top of this picture is Hesiodus A, and the right margin of the drawing is crossed by the great Hesiodus rille.

The low northern rampart of Hesiodus is broken by several narrow passes leading into the adjoining mare. Several indistinct crater forms are found here. To the east, the wall further degenerates into a series of ridges, probably only a few hundred feet high, crossed by another narrow pass.

Near this point the well-known Hesiodus rille originates, a great rift several miles wide that extends more than 200 miles eastward, interrupted only by a fault scarp near Cichus, to end near the north wall of Capuanus. This rille is a conspicuous object, readily seen in small telescopes. The accompanying drawing shows a second, small cleft intersecting the Hesiodus rille near its western end, and extending to a group of small hills northeast of Hesiodus. Although this latter cleft is not a difficult object, it apparently escaped the notice of Schmidt, Elger, Goodacre, and Wilkins.

On the southeast wall is Hesiodus A, a crater about nine miles in diameter, which was shadow-filled when I made my drawing. It is remarkable in having a complete concentric inner ring, easily seen under a higher lighting. This structure was first noted by Schmidt, on May 18, 1853. Hesiodus A thus seems to be an authentic example of so-called double-crater formation, one of the two cases known to me. The east inner slope of A's exterior wall is marked by several faint radial bands.

Of the details inside Hesiodus, most conspicuous is the deep crater Hesiodus D, approximately 2½ miles in diameter and situated near the center of the floor. It is not shown as a crater on Mädler's map of 1837 compiled from observations with a 3¾-inch refractor, a white patch being charted in its position. Goodacre was mistaken in suggesting this as a case of possible change, since crater D had been already recorded by Schröter in 1794. West of D is a smaller craterlet, very difficult to see under high illumination.

Less conspicuous on the floor of Hesiodus are a shallow saucerlike depression near the north wall, and a chain of minute craterlets at the base of the southeast wall, near A. Particularly noteworthy is a delicate cleft that originates near the north wall, traverses the eastern sector of the floor, ending near the craterlet chain. It is concentric with the wall, a characteristic shared by many clefts in other craters and near the borders of seas. Probably these features were formed by contraction and subsidence of the floors as the formations cooled.

This cleft seems to have been unreported previously, Goodacre even categorically asserting that the floor of Hesiodus contained nothing of the sort. It is an extremely difficult object, probably beyond the reach of all but the largest instruments in amateur hands.

ALIKA K. HERRING

The curious double ring of Hesiodus A is clearly shown in this reproduction of a small portion of sheet D6-b of G. P. Kuiper's "Photographic Lunar Atlas" (University of Chicago Press).

SUNSPOT NUMBERS

The following are corrected American sunspot numbers for June, and the numbers for July. They were prepared by the Radio Warning Services Section, Boulder Laboratories of the National Bureau of Standards, from AAVSO Solar Division observations.

June 1, 30; **2,** 25; **3,** 38; **4,** 37; **5,** 46; **6,** 43; **7,** 41; **8,** 40; **9,** 49; **10,** 57; **11,** 56; **12,** 58; **13,** 60; **14,** 72; **15,** 84; **16,** 102; **17,** 108; **18,** 101; **19,** 115; **20,** 126; **21,** 114; **22,** 108; **23,** 79; **24,** 68; **25,** 61; **26,** 42; **27,** 48; **28,** 46; **29,** 52; **30,** 53. Mean for June, 65.3.

July 1, 50; **2,** 57; **3,** 65; 4, 50; **5,** 37; **6,** 56; **7,** 54; **8,** 45; **9,** 60; **10,** 70; **11,** 78; **12,** 78; **13,** 74; **14,** 95; **15,** 99; **16,** 88; **17,** 83; **18,** 74; **19,** 78; **20,** 66; **21,** 63; **22,** 50; **23,** 65; **24,** 55; **25,** 58; **26,** 52; **27,** 33; **28,** 33; **29,** 30; **30,** 26; **31,** 33. Mean for July, 59.8.

Below are provisional mean relative sunspot numbers for August by Dr. M. Waldmeier, director of Zurich Observatory, from observations there and at its stations in Locarno and Arosa.

August 1, 39; **2,** 17; **3,** 24; **4,** 23; **5,** 14; **6,** 11; **7,** 9; **8,** 27; **9,** 51; **10,** 68; **11,** 92; **12,** 84; **13,** 92; **14,** 100; **15,** 108; **16,** 98; **17,** 85; **18,** 64; **19,** 69; **20,** 43; **21,** 51; **22,** 33; **23,** 29; **24,** 33; **25,** 47; **26,** 45; **27,** 54; **28,** 36; **29,** 60; **30,** 62; **31,** 53. Mean for August, 52.3.

HERE AND THERE WITH AMATEURS

The societies listed here are all open to the public. Most of them hold regular meetings once or twice monthly. Details of each society's program can be obtained from the official whose name and address are given here.

*Members receive *Sky and Telescope* as a privilege of membership.
†Member organization of the Astronomical League.
‡Member organization of the Western Amateur Astronomers.
°Society has junior section.
‖Independent junior society.

ALABAMA

BIRMINGHAM
Birmingham Astronomy Club *†
D. Hall, 100 Oak St., Trussville. GL 4-3117
FLORENCE
Tri-Cities Astronomy Club *
J. P. Smith, 609 W. Duncan Ave. AT 2-1292
HUNTSVILLE
Rocket City Astronomical Assn. *†
G. A. Ferrell, Jr., 621 Franklin St. JE 4-4809
TUSCUMBIA
Muscle Shoals Astronomical Society, Inc. *°
H. H. Russell, Jr., 302 N.E. Commons. EV 3-6717

ARIZONA

PHOENIX
Phoenix Observatory Assn. *‡
Mrs. P. Saladin, 3637 E. Verde Lane.
TUCSON
Tucson Astronomical and Astronautical Assn. *†‡
D. Strittmatter, 1840 E. Lee St. EA 5-9453

ARKANSAS

BENTONVILLE
Junior Astronomical Society of Bentonville
E. Vinson, 408 W. Central.
CAMDEN
Camden Astronomy Club *
B. Shelton, Chamber of Commerce, Hotel Camden. TE 6-6426
LITTLE ROCK
Arkansas Amateur Astronomy Club *†
W. Franke, 511 Louisiana St. MO 3-1681

CALIFORNIA

BURBANK
Burbank Astronomical Society
D. Rhoades, 1474 N. Evergreen St. TH 8-5880
CHINA LAKE
China Lake Astronomical Society *
C. Evans, Jr., 109-S Blandy. RI 5-0111
CONCORD
Mount Diablo Astronomical Society *
P. Schroth, 3119 Windsor Pl. MU 2-2090
ESCONDIDO
Palomar Amateur Astronomers *‡
M. A. Sloan, 2418 Alexander Dr. SH 5-7336
EUREKA
Astronomers of Humboldt *
W. N. Abbay, Jr., 1745 Margaret Lane, Arcata. VA 2-4403
FORTUNA
Astronomers of Southern Humboldt
W. Shreeve, Box 862.
FRESNO
Central Valley Astronomers *‡
G. Reavis, 626 W. Lamona. AM 4-9771
LA HABRA
La Habra Astronomical Society *
D. Dotson, 11014 S. Newcomb Ave., Whittier. OW 1-4011
LONG BEACH
Excelsior Telescope Club *†‡
B. Sproul, 130 5th St.
LOS ANGELES
Los Angeles Astronomical Society, Inc. ‡
Miss L. Carlson, 3047 Vista St., Long Beach (3). GE 9-9952
LYNWOOD
Lynwood Astronomy Club ‖
F. Williams, 5237 Elmwood Ave. NE 2-3907
NORTH HOLLYWOOD
San Fernando Valley Astronomical Society *
J. W. Harvey, 11640 Weddington St. PO 3-3011
OAKLAND
Eastbay Astronomical Society *‡
Mrs. S. Burke, 1528 E. 31st. KE 6-0691
OROVILLE
Feather River Astronomy Club
J. T. Jensen, Rte. 4, Box 4489. LE 3-0471
PALO ALTO
Peninsula Astronomical Society *‡
Miss A. Alksne, 4115 Amaranta Ave. DA 2-4406
PASADENA
Stony Ridge Observatory, Inc. ‡
E. Sloman, 1100 Armada Dr. SY 6-4731
POMONA
Junior Astronomical Society of Pomona Valley ‡‖
B. Goff, 2925 Grayburn St. LY 3-1917
RED BLUFF
Mount Lassen Amateur Moon Gazers °
F. Wyburn, Box 502. LA 7-4689
REDLANDS
Valley Amateur Astronomers *
Mrs. E. Patterson, 2842 Fremontia Dr., San Bernardino. TU 3-0565
RIVERSIDE
Riverside Astronomical Society *
H. E. Kaiser, 4868 Hedrick Ave., Arlington. OV 9-2574
SACRAMENTO
Sacramento Valley Astronomical Society *‡
Mrs. H. Smith, 1608 48th St. (19). GL 1-1483
SAN ANSELMO
Marin Astronomical Society *‡
N. Ash, 1554 Sir Francis Drake Blvd. GL 6-0233
SAN DIEGO
CRA Youth Astronomy Club ‖
D. Weisbrod, 4315 Hermosa Way (3). CY 5-4607
San Diego Astronomical Society
S. E. Collier, 10760 Melva Rd., La Mesa. HI 4-4430
San Diego Lunar Society
T. Smith, 9654 Candy Lane, La Mesa. HO 3-5290
SAN FRANCISCO
San Francisco Amateur Astronomers *‡
E. Taylor, 1626 Pacheco St. SE 1-4916
SAN JOSE
San Jose Amateur Astronomers *‡
W. Krumm, 10628 Larry Way, Cupertino.
Western Star Observers ‖
J. J. Mancuso, Jr., 1528 Ardenwood Dr. (29). AL 2-8984
SAN MATEO
San Mateo Astronomical Society °
R. Johnston, 806 Fiesta Dr. FI 5-7783
SANTA BARBARA
Santa Barbara Star Cluster ‡
Capt. C. Adair, 607 Miramonte Dr. WO 2-1717
SOUTH-GATE
Amateur Astronomical Society of South-Gate
J. R. McKnight, 1412 W. 87th St., Los Angeles (47).
STOCKTON
Stockton Astronomical Society *‡
T. Pullum, 2076 W. Inman St. (4). HO 4-0704
VAN NUYS
Valley Astronomy Club °
J. D. Truxton, 6615 Bevis Ave. ST 2-3736
Van Nuys Astronomical Society *
R. Chaldu, 14312 Cohasset St. ST 5-3006
WHITTIER
Whittier Amateur Astronomers Inc. *‡
R. K. Angel, 702 E. Walnut St. SY 9-7056
YUCAIPA
Yucaipa Amateur Astronomers *
C. Tapley, 33089 Yucaipa Blvd. PY 7-2632

COLORADO

ALAMOSA
Sky Valley Astronomical Society
D. Johnson, P. O. Box 402. JU 9-4493
BOULDER
Boulder Astronomical Society *†
H. H. Howe, 2419 Pennsylvania Ave. HI 3-1051
COLORADO SPRINGS
Colorado Springs Astronomical Society *†
M. Williams, 1306 E. Columbia. ME 3-9286
DENVER
Denver Astronomical Society *†‡°
R. A. Spencer, 4430 Gladiola St., Golden. CR 9-4682
PUEBLO
Pueblo Astronomical Society *†‡°
N. Onstott, 2421 Second Ave. LI 3-3348

CONNECTICUT

GREENWICH
Scanners' Club Astronomical Society
G. Shea, 102 Milbank Ave. TO 9-4474
HARTFORD
Central Connecticut Amateur Astronomers *†
C. Hammond, 17 Greystone Rd., W. Hartford. JA 3-8813
NEW HAVEN
Astronomical Society of New Haven, Inc. †
Mrs. H. Velardi, 108 Orange St. (10). UN 5-5637
NEW LONDON
Thames Amateur Astronomical Society *†
Miss D. Snell, P. O. Box 13, Groton. HI 5-2949
NEWTOWN
Western Connecticut Astronomical Society *†
J. Treffs, 6 Castle Hill Rd. GA 6-9093
STAMFORD
Fairfield County Astronomical Society *†°
N. B. Mickelson, 1 Gary Rd. DA 2-1300
STRATFORD
Boothe Memorial Astronomical Society *†
A. Farian, 227 Spring St., Bridgeport (8). ED 6-3486
WINSTED
Litchfield Hills Amateur Astronomy Club *†
Mrs. R. M. Graves, 151 Hinsdale Ave. FR 9-6459

DELAWARE

WILMINGTON
Delaware Astronomical Society *†
1301 Orange St. (5). OL 6-8364

DISTRICT OF COLUMBIA

WASHINGTON
Maret Astronomers Club *‖
P. Moretti, 3435 Yuma St. N.W. (8).
National Capital Astronomers *†°
Mrs. J. Stolarik, 7805 Canyon Dr. N.E. (27).

FLORIDA

COCOA
Central Brevard Junior Astronomical Society †‖
Mrs. A. Kleinfeldt, 1205 Montclair Rd.
DAYTONA BEACH
Daytona Beach Star Gazers
W. T. Thomas, 105 N. Halifax. CL 2-8049
EAU GALLIE
Indian River Astronomical Society *†
C. P. McDarment, Rte. 1, Box 55.
FT. WALTON BEACH
Northwest Florida Astronomical Assn. *
J. Sherlin, Flamingo Apt. 2, 156 Westview Ave., Valparaiso.
JACKSONVILLE
Astro-Gators Junior Astronomy Club ‖
C. Hofmann, Children's Mus., 1061 Riverside Ave. EL 5-6781
Jacksonville Astronomy Club, Inc. *
E. L. Rowland, Jr., 345 E. Forsyth St. EL 4-6815
KEY BISCAYNE
Key Biscayne Astronomical Assn. ‖
T. Ferris, 365 Pacific Rd. EM 1-5524
KEY WEST
Key West Astronomy Club †
Mrs. C. Lott, Box 284.
LAKELAND
Central Florida Astronomical Society *
C. Sammons, 1810 Fredericksburg Ave. MU 2-3223
MIAMI
Gulfstream Astronomical Assn., Inc. †
Mrs. G. Lobdell, 3169 New York St. HI 8-4288
Southern Cross Astronomical Society *†
A. P. Smith, Jr., 1601 S.W. 10th St. FR 4-7145
ORLANDO
Orlando Amateur Astronomy Club *
Dr. T. E. Gordon, Jr., 1410 N. Westmoreland Dr. GA 2-8226
ST. PETERSBURG
St. Petersburg Astronomy Club *†
Mrs. R. Angell, 233 5th Ave. N. 79-0544
TAMPA
Tampa Amateur Astronomical Society *†
E. Z. Randall, 407 W. Chelsea St. (3). 33-6391
WEST PALM BEACH
Astronomers Club of the Palm Beaches *
Mrs. D. D. Sinclair, Box 1108. JU 2-6830

GEORGIA

ALBANY
Albany Astronomy Society *
Mrs. J. Rachuba, 608 10th Ave. HE 6-2717
ATLANTA
Atlanta Astronomy Club *†°
W. H. Close, 225 Forkner Dr., Decatur. DR 3-3945
MACON
Macon Amateur Astronomers Club *†
G. Wood, Riverside Dr. SH 5-6486

HAWAII

HONOLULU
Hawaiian Astronomical Society *‡
E. G. Linsley, B. P. Bishop Museum (17). 85951

IDAHO

BOISE
Boise Valley Astronomical Assn.
Miss T. Hardy, 120 Horizon Dr.
IDAHO FALLS
Idaho Falls Astronomical Society *
R. Lee, 796 Saturn Ave. JA 3-0327
TWIN FALLS
Southern Idaho Amateur Astronomers
N. Herrett, 1220 Kimberly Rd. RE 3-0868

ILLINOIS

ARGONNE
Argonne Astronomy Club *†
H. F. DaBoll, 9700 S. Cass Ave. CL 7-7711
CHICAGO
Chicago Astronomical Society *
E. Ganek, 10921 Linn Ct.
Chicago Junior Astronomical Society *†‖
Miss D. Ahlgrimm, 2630 Park Dr., Flossmoor. SY 8-0360
DANVILLE
Danville Astronomical Society †
Miss S. Knopinski, 1010 E. Main St. HI 2-1673
ELMHURST
Key Biscayne Astronomical Assn., Ill. Branch †‖
J. Marshall, 329 Highview Ave. TE 4-5439
GALESBURG
Galesburg Amateur Astronomers *†
H. L. Horein, 1246 N. Morton Ave. DI 2-0873
GENEVA
Fox Valley Astronomical Society *
J. Zoda, 420 Fellows St., St. Charles. JU 4-2507
KANKAKEE
Kankakee Junior Astronomers ‖
D. Soucie, 235 S. Gordon. WE 3-6574
LAKE VILLA
Astronomical Society of West Lake County ‖
V. Biehl, Rte. 4, Box 196. EL 6-6861
MOLINE
Popular Astronomy Club *†
Dr. H. Nelson, 2439 17th Ave., Rock Island.
NORMAL
Twin City Amateur Astronomers *
Miss E. Jetton, 114 Greenwood Ave., Bloomington.
OAK PARK
Sirius Astronomical Society †‖
L. Zimmermann, 133 Franklin Ave., River Forest. FO 9-8186

PEORIA
Astronomy Section, Academy of Science *†
R. Van Zandt, 1100 N. Parkside Dr. 4-5621
RIVERDALE
Kalimar Astronomical Society *||
P. Flaherty, 14103 Wabash St. (27). VI 9-4375
RIVERSIDE
Vega Astronomy Club †||
C. Schulstad, 1628 N. Luna, Chicago.
ROCKFORD
Rockford Amateur Astronomers *†
A. R. Eastman, 2406 Clinton Rd. WO 3-5733
Rockford Astronomical Society *||
J. Brodine, 2125 Oxford St. WO 4-2933
SANDWICH
Sandwich Astronomical Society
N. Liepins, 803 Castle St. 5211
SOUTH HOLLAND
South Suburban Astronomical Society *†||
R. Hensel, 6714 Calumet Ave., Hammond, Ind.
SPRINGFIELD
Sangamon Astronomical Society
B. Schmitt, Jr., 308 E. Farley. LA 3-2088

INDIANA

EVANSVILLE
Evansville Astronomical Society *†
Dr. R. T. Dufford, 512 S. Weinbach Ave. (14). GR 6-7856
FORT WAYNE
Fort Wayne Astronomical Society, Inc. *
Mrs. B. Stoeckley, 1299 Somerset Lane. AN 1543
FRANKFORT
Clinton County Astronomy Club ||
D. Dilley, Rte. 6. Manson 1727
INDIANAPOLIS
Indiana Astronomical Society, Inc. *†°
W. Wilkins, 6124 Dewey Ave. (19). FL 7-5946
KOKOMO
Kokomo Astronomical Society *
P. Miles, Box 645. GL 2-9378
MADISON
Madison Junior Astronomy Society †||
T. A. Winkel, 607 N. East St. 387-R
SOUTH BEND
St. Joseph Valley Astronomical Society
Miss I. DeBruycker, 1023 S. Union St., Mishawaka. BL 5-0560
VALPARAISO
Valparaiso Univ. Astronomical Society
G. Arnold, Box 276, Valparaiso Univ. HO 2-7615

IOWA

BURLINGTON
Burlington Astronomy Club *
J. Polson, 2214 Barrett St. PL 4-6064
DES MOINES
Des Moines Div., Great Plains Astronomical Soc. *
R. T. Morehead, R.R. 1, Beaver Ave. (10).
DUBUQUE
Dubuque Astronomical Society *
H. W. Klauer, 1795 Adair St.
FORT DODGE
Fort Dodge Astronomy Club
W. W. Van Gundy, 1210 1st Ave. N. 4-4152
MARSHALLTOWN
Central Iowa Astronomers
Miss M. Leshko, 103 W. Nevada St. 6710
WATERLOO
Northeast Iowa Div., Great Plains Ast. Soc. *†
J. Kauzlarich, 834 Newton. AD 2-7780

KANSAS

TOPEKA
Topeka Astronomical Society *†
J. Starbird, 1817 W. First. CE 3-1762
WICHITA
Wichita Astronomical Society *†
S. Whitehead, 425 N. Lorraine (14). MU 2-6642

KENTUCKY

GLASGOW
Glasgow Junior Astronomical Assn. †||
C. W. Luster, 101 E. Cherry St. OL 1-5487
LEXINGTON
Bluegrass Astronomical Society *†°
J. Hayden, 336 Colony Blvd. 6-7657
LOUISVILLE
Louisville Astronomical Society *†
J. Bulluck, III, 3118 Widgeon Rd. (13). ME 4-3892
Louisville Junior Astronomical Society *†||
E. Novak, 2333 W. Lee St. (10). SP 8-0819

LOUISIANA

BASTROP
Morehouse Astronomical Assn.
R. Hancock, 909 Pleasant Dr. 377-J
LAKE CHARLES
Lake Charles Amateur Astronomers Club
C. Fronczek, 2511 German Rd., Westlake. HE 6-1797
METAIRIE
Pontchartrain Astronomy Society *†°
D. M. Clement, 5752 Warrington Dr., New Orleans (22). 288-2739
NEW ORLEANS
New Orleans Amateur Astronomers Assn. *†
W. E. Wulf, 2107 Annunciation St. JA 5-0706
SHREVEPORT
Shreveport Junior Astronomical Society *||
D. Schwartzenburg, 208 E. Rutherford. 868-1802

MAINE

PORTLAND
Astronomical Society of Maine †
Mrs. O. H. Mayberry, Millbrook Rd., Scarboro.

MARYLAND

BALTIMORE
Baltimore Astronomical Society *†
Maryland Academy of Sciences. Pratt Libr. Bldg., 400 Cathedral St. (1). MU 5-2370
GLEN BURNIE
Chesapeake Astronomical Society *
M. Meyerhoff, 1045 Thomas Rd. SO 6-5308
SILVER SPRING
APL Astronomy Club
I. Schroader, Applied Physics Lab., Johns Hopkins Univ., 8621 Georgia Ave. JU 9-7100

MASSACHUSETTS

CAMBRIDGE
Amateur Telescope Makers of Boston *†
W. R. Battersby, 14 Munroe Rd., Lexington (73). VO 2-2565
Bond Astronomical Club *†
R. C. Smith, 519 Morrissey Blvd., N. Quincy (71). GR 2-1938
LAWRENCE
Greater Lawrence Astronomical Society *
E. DesRosiers, 32 Oakland Ave., Methuen. MU 8-0944
NEW BEDFORD
Amateur Astronomy Club of New Bedford
M. Correia, 22 Ashley St. WY 2-6305
PALMER
Pioneer Valley Astronomy Club †
J. F. Conn. Greenwich Plains Rd., Ware. WO 7-4624
RUTLAND
Pommagussett Astronomical Society
M. S. Lubin, 45 Granite St., Worcester (4). PL 7-7278
SALEM
North Shore Astronomical Society †
F. Welch, 31 Fairview Rd.
SPRINGFIELD
Springfield Stars Club *†°
J. E. Welch, 107 Lower Beverly Hills, W. Springfield. RE 4-9179
WEST HARWICH
Cape Cod Astronomy Club *†
C. Perisho. HA 465
WEYMOUTH
South Shore Astronomical Society *†
Miss F. Winn, 74 Lincoln Ave., Wollaston. PR 3-9343
WORCESTER
Aldrich Astronomical Society *†
A. Nieuwenhoff, 3 Crestview Dr., Holden.

MICHIGAN

BATTLE CREEK
Battle Creek Amateur Astronomy Club †
Mrs. W. V. Eichenlaub, 47 Everett Ave. WO 2-3059
DETROIT
Detroit Astronomical Society, Inc. *†°
B. L. Reber, 22131 Ulster (19). KE 7-4197
FLINT
Flint Astronomy Club *†
Mrs. C. Adams, 610 Grand Blanc Rd., Grand Blanc.
Flint Junior Astronomy Club ||
D. G. Blondin, 3505 Holly Ave. (6).
GRAND RAPIDS
Grand Rapids Amateur Astronomical Assn. *†°
R. Larson, 1334 Benjamin S.E. (6). CH 3-8566
IRONWOOD
Range Astronomy Club †
L. Jacisin, 203 Balsam St. 1745-W
JACKSON
Jackson Astronomical Society *
E. Westerlund, 723 Bellevue. ST 2-1220
KALAMAZOO
Kalamazoo Astronomy Club †
Mrs. V. Shellman, 3811 Allandale Ave. FI 4-8295
LANSING
Lansing Amateur Astronomers *°
R. D. Bonner, 725 N. Magnolia Ave. IV 4-9834
MUSKEGON
Port City Amateur Astronomers *
C. Neir, 4342 Henry St.
PONTIAC
Pontiac-Northwest Detroit Astronomers Assn. *†
Mrs. E. Siddall, 3575 Teggerdine Rd., Clarkton.
SAGINAW
Saginaw Valley Astronomical Assn. *†
W. Burlew, 152 S. Sandow Rd., Midland. TE 5-4398
STURGIS
Sturgis Astronomy Group *°
Mrs. V. H. Reiff, Klinger Lake, R. F. D. 2, Box 112.

MINNESOTA

EDINA
Edina Astronomy Club †°
Dr. J. Korchik, 4936 Maple Rd. WA 6-2287
MINNEAPOLIS
Minneapolis Astronomy Club †
Mrs. M. B. Haarstick, Science Mus., Pub. Libr. FE 8-0781
Minneapolis Junior Astronomy Club ||
Mrs. M. B. Haarstick, Science Mus., Pub. Libr.
ST. PAUL
Astronomers' Club of St. Paul †||
R. Melarion, 896 E. Jenks Ave. (6).
St. Paul Telescope Club *†
C. Barklind, 576 Charles Ave. (3). CA 6-3944

MISSISSIPPI

LAUREL
Laurel Sky Club *†
Mrs. R. Waters, 13 Country Club Dr. 87068

MISSOURI

CARTHAGE
Our Lady's Astronomy Club †‖
M. Charland, 1900 S. Grand Ave.
FAYETTE
Central Missouri Amateur Astronomers *†
L. Boyd, 201 Pleasant, Mexico. JU 1-5822
JOPLIN
Joplin Astronomical Society *†‖
B. Vance, 622 Pearl Ave. MA 3-0842
KANSAS CITY
Astronomy Club of Kansas City *†
Mrs. L. Kinsey, 1522 Brush Creek (10). WA 3-3410
ST. JOSEPH
Midland Empire Astronomical Society *†°
Mrs. E. Davis, 206-B S. 14th. AD 4-0048
ST. LOUIS
Astronomers' Club of St. Louis †‖
K. Hornberger, 1111 Avant Dr. (37).
St. Louis Astronomical Society *†°
J. Ross, 5790 Kingsbury Pl. (12). PA 6-0458

NEBRASKA

OMAHA
Omaha Astronomy Club *
A. McDonough, 710 N. 58th St. (32). GL 3330

NEVADA

RENO
Astronomical Society of Nevada ‡
A. A. Garroway, 2040 Meadow View Lane. FA 3-0696

NEW HAMPSHIRE

KEENE
Keene Amateur Astronomers, Inc. *†°
P. N. Atwood, 173 Island St.
MANCHESTER
Clearview Astronomical Society ‖
Mrs. D. Trudeau, 1050 Hayward St. NA 3-8951
Manchester Astronomical Society *
R. E. Durette, 8 Keene St., Bedford. NA 5-8167
NASHUA
Merrimack Valley Astronomical Society *
A. J. Barrett, Box 155, Reeds Ferry. HA 4-3243

NEW JERSEY

CALDWELL
West Essex Astronomical Society
R. M. Greenley, 412 Bloomfield Ave. CA 6-6751
CLIFFSIDE PARK
Cliffside Stellar Research Group ‖
R. Bayer, 509 Lindbergh Ave. WH 3-9375
FOLSOM
Junior Amateur Astronomy Club ‖
J. Rhoda, 307 Cains Mill Rd., Williamstown.
FORT MONMOUTH
Society of Telescopy, Astronomy and Radio *†
W. E. Harris, 298 Broad St., Eatontown. LI 2-0476
JERSEY CITY
Gregory Mem. Obs. of Paul Revere Boys Club †‖
E. F. Jones, 339 Wayne St. (2).
RIVERTON
Riverton Astronomical Society °
W. McManus, 101 7th St.
ROSELLE PARK
Amateur Astronomers of Union County *†
W. Dean, 10 Shady Lane, Fanwood.
RUTHERFORD
Astronomical Society of Rutherford
Mrs. A. Cox, 478 Riverside Terr. WE 9-0453
SWEDESBORO
The Skyrockers °
V. Pandolfo, R.F.D. 1, Box 24. HO 7-0125J
TEANECK
Bergen County Astronomical Society †
W. DeForge, Jr., 424 W. Anderson St., Hackensack. HU 9-3436
UNION CITY
Hudson County Astronomical League
R. Wurgel, 634 39th St. UN 5-0724
UPPER MONTCLAIR
Montclair Telescope Club *
R. Boegehold, 280 N. Mountain Ave. PI 6-0495

NEW MEXICO

ALBUQUERQUE
Albuquerque Astronomers *†
D. Judd, 320 13th St. N.W. CH 3-4955
LAS CRUCES
Astronomical Society of Las Cruces *†‡
J. E. Durrenberger, Box 625. JA 6-2968

NEW YORK

ALBANY
Albany Astronomical Assn. *†°
V. D. Manti, 36 Marsdale St. IV 2-7279
BEACON
Texaco Astronomy Club †
F. C. McCoy, 48 W. Willow St. 3312
BINGHAMTON
Roberson Science Assn. °
D. E. Masters, 161 Trafford Rd. RA 2-5055
Astronomical Society of Broome County °
J. Calabrisi, 17 Jutland Rd. RA 4-8438
BRIGHTWATERS
Long Island Junior Astronomical Society ‖
R. Spivak, 517 Manatuck Blvd. MO 5-3250
BUFFALO
Buffalo Astronomical Assn. *†
L. Reinagel, 194 Westgate Rd., Kenmore (17). DE 3455
CHAPPAQUA
Northern Westchester Astronomical Society *
W. P. Smith, 130 Castle Rd. CE 8-3853
CORNING
Corning Astronomy Club
Mrs. E. Johnston, 106 Jennings St. 2-5142
FARMINGDALE
Long Island Students of Astronomy
W. Huebner, 69 Duane St. CH 9-8793
HASTINGS
Westchester Astronomers League *
V. Volk, 749 N. Broadway. GR 8-3758
HUNTINGTON
Long Island Observers' Assn. *†
J. Littmann, 51 Cliftwood Dr. HA 3-6316
JAMESTOWN
Astronomers Guild of Jamestown *
B. Hanson, 613 Stowe St. 56245
MASSAPEQUA
Mid-Island Amateur Astronomers *
Mrs. B. Witham, 84 Bay Dr. PY 8-0029
MELVILLE
Airborne Recreation Assn. Astronomy Club *
A. Dresner, 224 Grange St., Franklin Square. IV 9-3098
NEW YORK
Amateur Astronomers Assn., Inc. *†
R. E. Priest, 223 W. 79th St. (24). TR 4-9064
Junior Astronomy Club †‖
New York Univ., 100 Washington Sq. E. (3).
PATCHOGUE
Long Island Astronomical Society
R. Franklin, 174 Jayne St.
PEARL RIVER
Rockland Astronomical Society
H. Hepworth, Greenbush Rd., Blauvelt. EL 8-3706
ROCHESTER
Astronomy Section, Academy of Science †
W. W. Whyman, 193 Oak St., Batavia. FI 3-1899
SCHENECTADY
Bishop Gibbons Astronomy Club *†‖
Br. A. E. Newman, F.S.C.H., 2602 Albany St. EX 3-3131
Schenectady Astronomy Club *†
R. Cooper, 22 Wagner Ave. (4).
SYRACUSE
Syracuse Astronomical Society *†
C. D. Fuller, 130 Falls Blvd., Chittenango. NT 7-6881
TROY
Rensselaer Astrophysical Society *†
Dr. R. Fleischer, Rensselaer Polytechnic Inst.
Troy Astronomy Club
D. Harris, 1032 19th St., Watervliet. AR 3-1266
UTICA
Utica Amateur Astronomers *†
W. Burak, Sr., 1663 Lincoln Ave.
YONKERS
Yonkers Astronomy Club †
B. Simon, 9 Valley View Dr. YO 8-7681

NORTH CAROLINA

CHAPEL HILL
Chapel Hill Astronomy Club *†
B. Melvin, Rte. 2. 9-9447
CHARLOTTE
Charlotte Amateur Astronomers Club *†
Mrs. P. Nowlin, 946 Bromley Rd.
GREENSBORO
Greensboro Astronomy Club *†
Mrs. M. Freeland, 2729 Robinhood Dr. BR 5-3773
WINSTON-SALEM
Forsyth Astronomical Society *†
K. A. Shepherd, 903 West End Blvd. PA 2-1631

NORTH DAKOTA

GRAND FORKS
Red River Astronomy Club *
Miss M. Barlow, 704 Cottonwood St. 2-2473

OHIO

AKRON
Astronomy Club of Akron *
C. Yunker, 161 Goodview Ave. (5). RE 3-5629
BAY VILLAGE
Junior Astronomy Society of Lake Erie Jr. Mus. †‖
Mrs. E. W. Fleming, 630 Canterbury Rd. TR 1-3742
CINCINNATI
Cincinnati Astronomical Assn. *
G. A. Lineback, 2933 Cortelyou Pl. (13). JE 1-1442
Cincinnati Astronomical Society *†
Miss M. Stone, 5767 Cheviot Rd. (39). WE 1-0954
CLEVELAND
Cleveland Amateur Astronomers Club
J. B. Breckinridge, Mus. of Nat. Hist. Planetarium, 10600 East Blvd. (6). SW 1-7966
Cleveland Amateur Telescope Makers
Miss M. Flahive, Museum of Natural History, 10600 East Blvd. (6). SW 1-7966
Cleveland Astronomical Society
Dr. J. J. Nassau, Warner and Swasey Obs., Taylor Rd., E. Cleveland (12). GL 1-5625
Cuyahoga Astronomy Club
W. Baum, 1257 Cranford Ave., Lakewood (7). AC 1-2697
COLUMBUS
Columbus Astronomical Society *†
Mrs. J. Gann, 420 N. Cassady Rd. (9). CL 2-8421
DAYTON
Miami Valley Astronomical Society *†°
F. Sutter, 5038 Far Hills Ave. (59). AX 3-1827

DeGraff
Miami River Astronomy League ||
P. Carr, Box 417. 585-4243
Elyria
Black River Astronomical Society *†
G. Diedrich, 653 Weller Rd. FA 2-4363
Hillsboro
Hillsboro Astronomical Society *
Mrs. D. N. McBride, Box 85. EX 3-2075
Lima
Lima Astronomy Club *†
Mrs. V. Schneider, 706 St. Andrews Blvd.
Lorain
Black River Astronomical Society *†
L. Rick, 685 N. Ridge Rd. E. CE 3-5321
Mansfield
Richland Astronomy Society *
G. E. Hamilton, 99 Brickman Ave. LA 4-4705
Marietta
Marietta Astronomical Society °
Miss L. E. Cisler, Cisler Terrace. FR 3-0231
Massillon
Massillon Astronomy Club *
W. J. Crawford, 1545 First St. N.E.
Mount Vernon
Mount Vernon Astronomy Club
L. Waddell, 407 Maplewood Ave. EX 2-4396
Newark
Newark Astronomical Society
G. Cooperrider, 326 N. 11th St. FA 3-0452
Steubenville
Ohio Valley Amateur Astronomers *†
F. Donaldson, Box 270. AT 2-5821
Toledo
Toledo Astronomical Society °
E. D. Edenburn, 4124 Commonwealth Ave. (12). GR 9-3658
Warren
Mahoning Valley Astronomical Society *
Mrs. C. R. Prather, 1363 Drexel Ave. N.W. EX 3-3483
Youngstown
Youngstown Astronomy Club *
D. Recklies, 806 E. Florida Ave. ST 2-0853

OKLAHOMA

Bartlesville
Bartlesville Astronomical Society *†
E. L. Clark, 2054 Johnstone. FE 6-3650
Oklahoma City
Astronomy Club of Oklahoma City *†
E. Brett, 2624 N.W. 34th St.
Tulsa
Astronomy Club of Tulsa *†
Mrs. G. Rose, 4697 S. Columbia Ave. (5). RI 7-6729
Oklahoma Astronomical Society †||
L. Dicken, 1332 S. Sandusky (12). MA 6-9644

OREGON

Eugene
Astralites, Inc. *†°
R. Fidler, 669 E. 13th St., Apt. 4. DI 3-5387
Grants Pass
Rogue Valley Astronomers and ATM's
H. R. Dickey, 2543 Hamilton Lane. GR 6-6941
Portland
Amateur Telescope Makers and Observers †‡
Miss M. Kobs, 5215 N.E. 30th Ave. (11). AT 2-8843
Portland Astronomical Society *†
Mrs. M. Krutsinger, 6525 N.E. Davis (16). AL 4-1491
Salem
Salem Astronomical Society *†°
Mrs. B. W. Christensen, 1430 Marshall Dr. EM 4-6626
Seaside
Seaside Amateur Astronomical Society ||
R. Sealy, 2456 Ocean Vista Dr. RE 8-6119

PENNSYLVANIA

Allentown
Lehigh Valley Amateur Astronomical Soc. *
Mrs. O. G. Lewis, 413 N. Ambler St., Quakertown. KE 6-3380
Bristol
Polaris Astronomical Society *
Mrs. J. Kovach, 3524 Carnarvon Ave. ST 8-1892
Butler
Penn Township Junior Astronomical Society ||
K. M. White, Rte. 6. NIX 2366
Clearfield
Amateur Astronomers of Clearfield *†
L. Gearhart, Jr., 114 S. 5th St. PO 5-5748
Erie
M31
R. S. Cadwallader, 916 Kahkwa Blvd. GL 4-0229
Harrisburg
Astronomical Society of Harrisburg *†
H. Bitner, 700 Glen St. KI 5-5463
Millvale
Shaler Township Junior Amateur Astronomers ||
C. Raible, 200 Rebecca Sq. (9). TA 1-5193
Philadelphia
Amateur Astronomers of Franklin Inst. †
E. F. Bailey, Franklin Inst. (34). LO 4-3600
Brahe Astronomical Society ||
S. Karpchuk, Jr., 3304 Oakmont Ave. (36).
Rittenhouse Astronomical Society *†
D. D. Davis, Franklin Inst. (34). LO 4-3600
Pittsburgh
Amateur Astronomers Assn. of Pittsburgh *†°
F. M. Garland, 210 Park Pl. (37). FO 4-3223
Junior Amateur Astronomers Assn. of Pittsburgh *†||
Miss B. Bougher, 2919 Mattern Ave. (16). LO 3-1715
Scranton
Lackawanna Astronomical Society
Miss J. Woelkers, 311 Willow St. DI 2-8593
Springdale
Allegheny Valley Amateur Astronomers Assn. *†
W. E. Stocks, 215 Carson St. BR 4-8835
State College
Nittany Valley Amateur Astronomers
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San Antonio Astronomy Club †
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Richmond Assn. of Junior Astronomers ||
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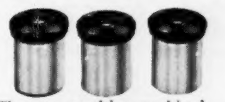

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Cat. #SRT-350..................**$14.50**

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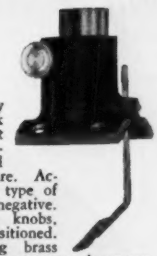

The most mechanically perfect focusing is by rack and pinion. This mount takes standard 1¼" eyepieces. Full 3½" of travel — more than ever before. Accommodates almost any type of eyepiece — positive and negative. Two knurled focusing knobs, variably tensioned and positioned. Solid cast-metal sliding brass tube — close tolerance prevents looseness. Mount aligns itself to any type tube. Four mounting holes, nuts and bolts included. Eye mount has square-rod-type diagonal holder which prevents loose alignment and vibration. Rod tempered to minimize temperature changes. Adjustable for 3" to 8" scopes, also 12" scopes if so specified at no extra cost. Order one or more of the complete eyepieces described below at the same time you send for this rack-and-pinion device, which accommodates any of our eyepieces perfectly.

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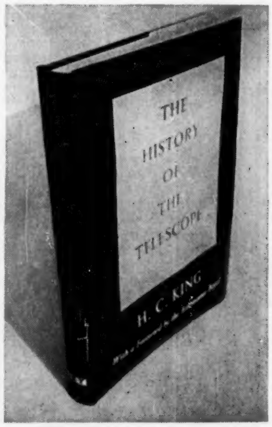
An Atlas of the Moon's Far Side, the most recent Sky publication (jointly with Interscience Publishers, Inc.), is the full account of the photographic reconnaissance of the moon by the Soviet Union's third space probe, Lunik III. Launched on October 4, 1959, the probe carried advanced scientific equipment that included photographic and television systems; it passed around the moon to view a portion of the lunar surface that is perpetually hidden from Earth. On command, Lunik III photographed the moon's far side for 40 minutes, and these images were later telecast to earth.

The results of this achievement were compiled for the U. S. S. R. Academy of Sciences by three leading Soviet astronomers, N. N. Barabashov, Kharkov University Observatory, A. A. Mikhailov, Pulkovo Observatory, and Yu. N. Lipsky, Sternberg Astronomical Institute. Now the complete Russian *Atlas of the Opposite Side of the Moon* has been translated into English by Richard B. Rodman of Harvard Observatory. This volume contains every fact, every illustration, in the Russian original. Included are all 20 full-page plates with their 30 halftone pictures of hitherto invisible lunar features. These pictures were obtained by an ingenious electronic filtration process, described in the text, from the best Lunik III original negatives. An important part of the book is the catalogue of 498 lunar formations. The definitive map is given in two forms — both as four full pages in the book, and as a separate 17" x 24" folding sheet. *200 pages (8⅜" x 11⅞"), 20 plates,* **$7.00.**



From numerous original sources, Henry C. King, now director of the London Planetarium, has compiled a full account of the development of the telescope from crude early types to the powerful giants of today. In **The History of the Telescope,** many instruments are illustrated by historic drawings and modern photographs. More than an account of the evolution of the telescope, this book gives much information about craftsmen and instrument makers, and about associated advances in astronomy. It provides a gold mine of ideas for amateur telescope makers. *456 pages, 196 illustrations,* **$7.50.**

Making Your Own Telescope, by Allyn J. Thompson, contains complete step-by-step directions for making and mounting a 6-inch reflector at low cost. In easy-to-understand chapters, the amateur learns how to grind, polish, and figure the mirror, and how to make an equatorial mount that will provide a sturdy, solid support for his optics. *211 pages, 104 illustrations,* **$4.00.**

An important recent booklet for all optical enthusiasts is **Construction of a Maksutov Telescope,** by Warren I. Fillmore. It describes the ordering, grinding, testing, and assembling of the optical and mechanical parts of a Gregory-Maksutov 6-inch f/15 telescope, including ideas for accessories. Printed by the photo-offset process, the monograph is illustrated with many photographs and drawings showing equipment tests, lens curves, Ronchi patterns, and the completed telescope. *29 pages,* **$1.00.**

Other Sky booklets: **Splendors of the Sky,** *36 pages, 66 illustrations,* 50 cents; **Relativity and Its Astronomical Implications,** by Philipp Frank, 75 cents; **How To Build a Quartz Monochromator** for Observing Prominences on the Sun, by Richard B. Dunn, 50 cents; **The Story of Cosmic Rays,** by W. F. G. Swann, 75 cents.

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SKY PUBLISHING CORPORATION Harvard Observatory, Cambridge 38, Massachusetts

BOOKS AND THE SKY

SCIENCE IN SPACE

Lloyd V. Berkner and **Hugh Odishaw,** editors. McGraw-Hill Book Co., Inc., New York, 1961. 458 pages. $7.00.

THE material that makes up *Science in Space* originally appeared as reports published individually by the National Academy of Sciences-National Research Council in 1960 and 1961, as part of a larger study prepared by the Space Science Board.

The volume is divided into seven parts: 1, a general review of space exploration, types of vehicles available for scientific use, applications of space probes and satellites, man's role in the venture, and the results of exploratory space experiments; 2, gravity; 3, the earth; 4, the moon and planets; 5, fields and particles in space; 6, the stars; and 7, life sciences. An appendix explains the organization and function of the Space Science Board.

The book is definitely not for the general reader, but it should be valuable to the nonspace scientist who wants to know more about the status and progress of this exciting new field. All selections are written by recognized scholars, including Nobel laureates Harold C. Urey and Joshua Lederberg.

Among the 20 chapters of the book are the following: Some Aspects of Geodesy; Meteorology; Rocket Research and the Upper Atmosphere; The Interplanetary Gas and Magnetic Fields; The Acceleration and Propagation of Particles within the Solar System; The Geomagnetically Trapped Corpuscular Radiation; The Sun; and Galactic and Extragalactic Astronomy.

Within the limits of this review it is impossible to summarize the contents of each of the book's various parts. However, a brief recapitulation of some specimen sections may illustrate the scope of coverage and the degree of scholarship involved.

Written by R. H. Dicke, professor of physics at Princeton University, Chapter 3 on the nature of gravitation briefly sums up the three classical checks on the astronomical effects of relativity: advance of Mercury's perihelion, gravitational red shift, and gravitational deflection of light. Discussed in somewhat more detail and developed to a greater degree are the basic differences in point of view between Mach and Einstein, a well-developed review of the several theories of variable gravitational interactions, and the astronomical and geological implications of a varying gravitational constant. The chapter concludes with some interesting proposals for using satellites as research tools, for example, measuring the relativistic advance of an artificial satellite's line of apsides.

In his article, "The Moon," Dr. Urey gives a timely and up-to-date summary of what we know and suspect about Earth's only natural satellite. He holds that the moon is possibly the most important celestial object for space investigation. Unlike planets with atmospheres (which imply evolution and change), the moon is basically the same now as it was $4\frac{1}{2}$ billion years ago. It "probably has considerably less iron than the Earth and, in fact, may have considerably less than is recorded in the usual abundance of the elements. This would seem to indicate that the Moon may have the same composition as the Sun with respect to the nonvolatile fraction of the elements."

Dr. Urey discusses the lunar topography and interior. He suggests that an artificial satellite be orbited around the moon to determine its mass and mass distribution, measure its magnetic field, and look for possible trapped-radiation belts resulting from such a field.

Dr. Lederberg's Chapter 20, Exobiology: Experimental Approaches to Life Beyond the Earth, is well organized and clear, but slightly academic and dry. It is factual and does not suffer from the imaginative fallacies that so often seduce writers dealing with life on other planets. Obviously, any such discussion must be predicated on a clear definition of life, and any such definition must have some philosophical components. Dr. Lederberg does not dwell at length on these refinements, but reviews the various theories of life's origin, including Arrhenius' intriguing hypothesis of panspermia. The chapter ends with some suggested experimental approaches to a systematic study of exobiology.

FREDERICK I. ORDWAY, III
Marshall Space Flight Center

CHANGING VIEWS OF THE UNIVERSE

Colin A. Ronan. Macmillan Co., New York, 1961. 206 pages. $3.95.

CHARACTERIZATION of this competent little book is difficult. It was written by a thoroughgoing scholar, but is to be enjoyed, not studied. The author points out in his preface that the book "is not a formal history of astronomy . . . nor is it a formal history of cosmology. Rather it is a sketch of the attitudes with which men have looked at the cosmos."

By inspecting the world's astronomical climate throughout history, this volume aptly introduces a new series edited by Mr. Ronan and Patrick Moore, entitled A Survey of Astronomy. This first book presupposes no more than a modicum of acquaintance with astronomy, yet can be read with profit by the professional who has not previously delved into the history of science.

Most commendable is the author's ability to enter into the spirit of the times he treats, stripping himself of the prejudice caused by hindsight. He very rarely

indulges in a supercilious word or false juxtaposition of ideas, no matter how fantastic the theory that is under consideration.

His presentation of early Greek philosophy and cosmology is extremely lucid, though the theories of the pre-Socratics are perhaps made to appear a little more consistent and coherent than the primary sources would warrant. He gives the impression of having read Aristotle and seen the reason for his profound influence; in this Mr. Ronan stands apart from many historians of science. Compare his statement, "Whatever we may now know, we cannot but admit that this explanation by Aristotle was both ingenious and self-consistent," with Bertrand Russell's, "Aristotle, it should be said, has been one of the great misfortunes of the human race."

Although the basis upon which Aristotle built is mentioned during the treatment of Anaximander, Aristotle's reasons for claiming that the universe is geocentric are not developed. This would have been most helpful in setting the stage for Galileo's time.

From a historical point of view, the weakest treatment is of the period between the Greeks and Copernicus, perhaps because little astronomical advance occurred then. But it is unfair to say that Christianity "showed little interest in knowledge for its own sake." There have from earliest times been two factions in the Christian church, often at loggerheads, one chiefly interested in the preservation and transmission of doctrine, the other in advancing man's knowledge.

To quote from St. Ambrose without quoting St. Augustine is to give a one-sided picture of the time. To say simply that St. Thomas Aquinas' synthesis of (the largely atheistic) Aristotelian cosmology with Christian faith "was successful, so much so that . . . [it] became synonymous with orthodoxy," ignores the difficulties St. Thomas had with church leaders, and also such vastly differing views as those of St. Bonaventure and Duns Scotus. In treating Arabic cosmology, the author does not even mention Al Farabi, Avicenna, and Averroes, who were particularly influential in forming Western thought.

Surveying the complex intellectual climate at the time of Copernicus, Galileo, and Kepler, Mr. Ronan is very impartial. He points out that Copernicus would never have dedicated *De Revolutionibus* to Pope Paul III if there were any danger of its condemnation, gives what is probably the best interpretation of Osiander's preface, and states that Galileo's difficulties with ecclesiastical authorities were as much a result of his attitude toward the Bible as of his view of the universe. There are, of course, nuances that are not clearly brought out, inevitable in a brief treatment, but the general picture of the period is the most accurate I have seen.

The remainder of the volume occasionally degenerates into a catalogue of inventions and famous names, many of which could have been omitted to leave more room for the penetrating and carefully worded insights into theories which brighten these pages.

One could wish the coverage were less brief, at times to the point of being tantalizingly cryptic, but to avoid this would destroy the book. Intended as no more than a sketch, it is very successful, and well worth the few hours required to read it.

G. A. B.

THE MILKY WAY GALAXY

Ben Bova. Holt, Rinehart and Winston, New York, 1961. 228 pages. $5.00.

"MODERN ASTRONOMY," the author states in his acknowledgements, "is a sprawling complex field of study involving an overwhelming mass of detail." This is one of the major problems facing the writer of a book on popular astronomy. Shall he omit many of the intricate details? If he does, his results will probably be labeled suitable for children. Or should he include the details, mentioning the myriad problems facing astronomers in charting the heavens? In this case his book runs the risk of being considered a text, or used only for reference.

The Milky Way Galaxy is balanced between these approaches while retain-

ing the advantages of both. Written in an informal, chatty style, it gives the reader the impression that a learned astronomer has taken time to sit down and explain celestial phenomena in nontechnical language. And the author is thorough; he makes his point without being pedantic.

In the first chapter, Mr. Bova gives a brief history of astronomy, an introduction to the measurement of stellar distances, and a warning that astronomy is by no means a static science. This is a good point to make early, and it is reinforced several times in subsequent chapters. Readers of a scientific volume all too often take what they read as the absolute truth. In this book the shortcomings of a given method or the uncertainty of a result are mentioned. Information is often said to be "reliable, but not infallible."

Involved principles are everywhere made clear by simple, analogous examples. This is especially valuable in the discussions of parallax measurement and the quantum theory of light, where the abstractness of an amount, such as a star's apparent shift on the celestial sphere, or the concept of a photon, makes it difficult to visualize.

Vast time measurements and vaster distances are clarified by translation into more familiar figures. The solar system and its members are put in their place in the Milky Way, "where time is reckoned by the 200,000,000-year revolution of the galaxy, where man is an alien invader from a dust mote circling a mediocre star."

Worthy of note is the author's inclusion of practical applications of principles. The theory behind the Doppler shift, for example, may be comprehended, but, unless they are told, not many laymen realize that the shift can be measured in a star's spectrum.

Astronomical terminology can be overwhelming. Here the author accomplishes the difficult feat of defining his terms as he goes along, making each whole paragraph lucid and understandable. For comparatively irrelevant information, such as the measurement of the sun's magnetic field in gauss, the explanation is brief, yet adequate. Terms that are similar are clearly differentiated – heat versus temperature and mass versus weight, for example.

Mr. Bova follows another practice that readers will appreciate, that of continuously summarizing previous topics. By the inclusion of "you remember that" and "as we have already seen," the author makes it easier for the reader to fit the new concept into the structure of what has previously been presented.

The volume contains such useful tables as equivalences of the metric and English weight systems and characteristics of the 20 brightest stars. In appendixes are found handy items: the lower case Greek alphabet, etymology of star names, various formulas for absolute magnitude, mass, and distance.

The Milky Way Galaxy is a thorough treatment of its subject matter, written in a clear, easy-to-read style. It is not a book that one new to the field can dash off in a night's reading – it contains too much information for that. For the serious amateur astronomer who has become rusty on a point or two, or for the layman who wants to know more about the heavens and is willing to spend some time digesting concepts and theories, Ben Bova's work should be enjoyable and rewarding.

RUTH CANSTEIN
Bronx, N. Y.

NEW BOOKS RECEIVED

PATTERNS IN THE SKY, *Julius D. W. Staal*, 1961, *Hodder and Stoughton Ltd.*, London E.C.4, England. 200 pages. 15s.

Legends of the constellations are recounted by the assistant director of the planetarium at Johannesburg, South Africa. The mythological constellation figures are outlined on simple star charts, and many celestial objects of special interest are briefly described.

GEOCHRONOLOGY OF ROCK SYSTEMS, *Franklin N. Furness*, editor, 1961, *New York Academy of Sciences*. 431 pages. $5.15, paper bound.

The problems of determining the ages of rocks and new results concerning the geological time-scale were discussed in 55 papers at a conference in New York City on March 3-5, 1960. The proceedings are now published as Vol. 91, Art. 2, of the *Annals* of the New York Academy of Sciences.

SPLENDOR IN THE SKY, *Gerald S. Hawkins*, 1961, *Harper*. 292 pages. $5.95.

The progress of astronomy from prehistoric sky-gazing to modern knowledge of the nature of heavenly bodies is reviewed for general readers in this well-illustrated volume. The author is director of Boston University Observatory and a meteor expert.

THE EARTH, THE PLANETS AND THE STARS, *K. E. Edgeworth*, 1961, *Macmillan*. 193 pages. $5.75.

Some theories of the origin of planets, stars, and stellar systems are summarized in simple language. The author emphasizes his own views, many of which were first advanced in a 1946-48 series of articles in the *Monthly Notices* of the Royal Astronomical Society.

ATLAS OF THE UNIVERSE, *Br. Ernst* and *Tj. E. de Vries*, 1961, *Thomas Nelson*. 226 pages. $9.95.

Almost 100 large halftone plates and numerous line diagrams illustrate this encyclopedia, which discusses astronomical topics from "A" (the abbreviation for Angstrom) to the zodiacal light. This nontechnical work has been translated from the original Dutch by D. R. Welsh.

TABLES OF BLACKBODY RADIATION FUNCTIONS, *Mark Pivovonsky* and *Max R. Nagel*, 1961, *Macmillan*. 481 pages. $12.50.

Particularly useful to specialists in the infrared is this extensive tabulation of Planck's radiation law and a number of related functions. Conversion data have been provided to prevent obsolescence through changes in the values of atomic constants.

AN ATLAS OF THE OTHER SIDE OF THE MOON, *N. P. Barabashov, A. A. Mikhailov, Yu. N. Lipskiy*, editors, 1961, *Pergamon*. 141 pages. $7.00.

Details of reconstruction of the Lunik III photographs and information they contained were published in Russian under the auspices of the U. S. S. R. Academy of Science in 1960. This translation by Leon Ter-Oganian includes the catalogue of lunar formations.

THE STORY OF THE STARS, *Terry Maloney*, 1961, *Sterling*. 48 pages. $2.50.

Intended for boys and girls from eight to 12, this little book tells about the distances and sizes of stars, and has something on special kinds of stars and also nebulae. Most illustrations are drawings by the author.

SCIENCE SURVEY — 2, *A. W. Haslett* and *John St. John*, editors, 1961, *Macmillan*. 372 pages. $7.50.

This second issue of an annual survey contains 23 scientific summary articles written for the layman by recognized authorities. The two astronomical chapters are on stellar evolution, by O. J. Eggen, and on the scale of the universe, by R. H. Garstang. The first volume was listed on page 228 of SKY AND TELESCOPE for October, 1960.

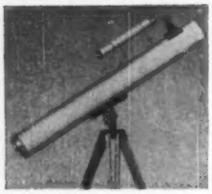
MEDICAL AND BIOLOGICAL ASPECTS OF THE ENERGIES OF SPACE, *Paul A. Campbell*, editor, 1961, *Columbia University Press*. 491 pages. $10.00.

The Air Force School of Aerospace Medicine sponsored a symposium in late October, 1960, at which the papers in this volume were first given. There are summaries of solar radiation, cosmic rays, and the material contents of interplanetary space. Other chapters deal with radiation hazards in spaceflight, and the practical utilization of solar energy by space vehicles. Extended bibliographies are provided.

APPARENT PLACES OF FUNDAMENTAL STARS — 1962, 1961, *Astronomisches Rechen-Institut*, Mönchhofstrasse 12-14, Heidelberg, West Germany. 510 pages.

The 22nd of a series, this annual volume is prepared under the auspices of the International Astronomical Union. It lists apparent positions of 1,535 bright stars, giving right ascensions to 0.001 second and declinations to 0".01, at 10-day intervals.

In the United States, order from Cincinnati Observatory, Cincinnati 8, Ohio. Advance payment of $8.00 per copy is required (covering postage and packaging); make checks payable to Cincinnati Observatory APFS. European orders should be sent to Verlag G. Braun, Karl Friedrich Strasse 14-18, Karlsruhe, West Germany.



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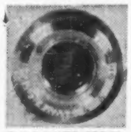

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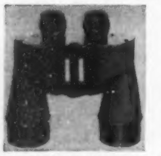

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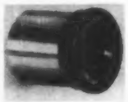

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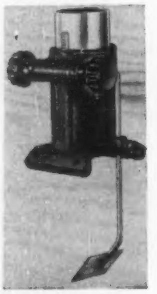

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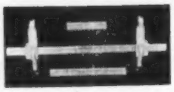

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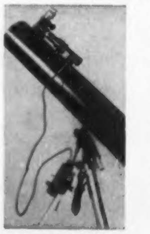

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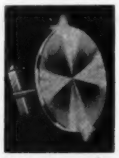

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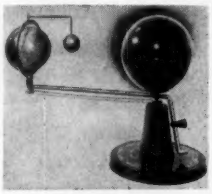

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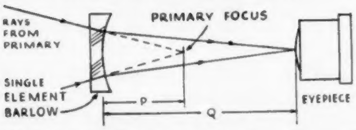

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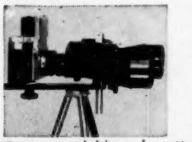

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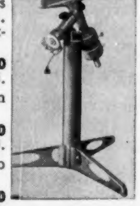

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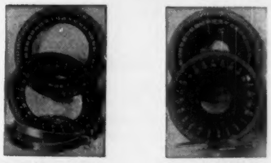

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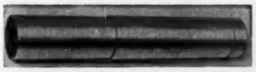

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GLEANINGS FOR ATM's

CONDUCTED BY ROBERT E. COX

AN IMPROVED 4¼-INCH UNOBSTRUCTED OBLIQUE REFLECTOR

ABOUT three years ago in this department (August, 1958, page 533), I described an 8-inch off-axis reflector based on the design of Anton Kutter, whose own 12-inch *schiefspiegler* was pictured on the cover in December, 1958. The Gleanings department subsequently published Mr. Kutter's *Bulletin A*, where it was explained that by restricting the aperture to about four inches, an amateur with only moderate telescope making experience could build an off-axis instrument of fine definition.

A telescope of this kind was described by C. B. Avera, Jr., in this year's May issue (page 293), where some of its principles were explained, so they do not need repeating here. There is a slight blocking of the light falling on the primary mirror, but Mr. Kutter points out that by increasing the focal length this difficulty can be avoided. To help American amateurs, he has approved publication of the optical layout of my 4¼-inch telescope, which has a secondary positioned entirely outside of the primary's incoming cone of light.

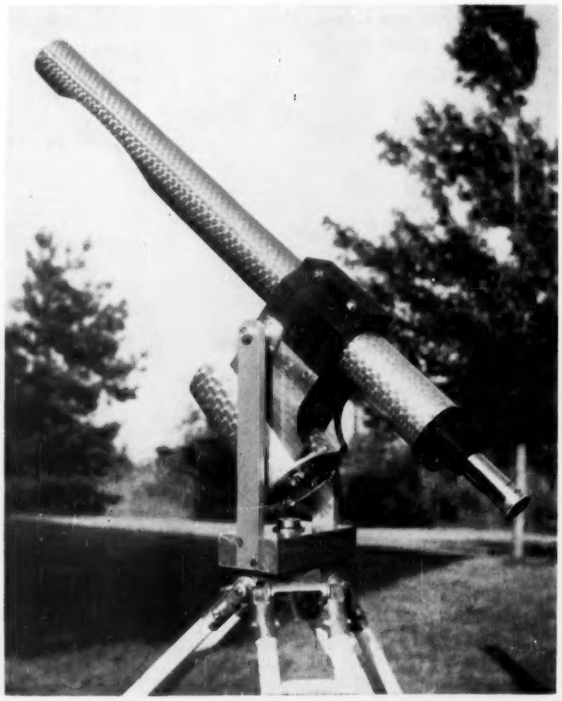
All dimensions necessary for construction of the instrument are given in the drawing and the table. Mr. Kutter's figures are changed slightly to add an extra 3" of focal length at the eyepiece end, where a zenith prism or star diagonal can be used just as in observing with a refractor. Better balance is achieved for the whole instrument. The work in making this off-axis telescope is simple and straightforward, with neither castings nor special tools required.

Both the 4¼-inch primary mirror and the 2.2-inch convex secondary are spherically figured, each having a radius of curvature of 127.5". In fact, I converted the polished plate-glass tool, ⅝" thick, into my secondary. After coarse grinding, this tool was biscuit-cut from the back to within 3/32" or so of the front convex surface and the cut was filled with plaster of Paris.

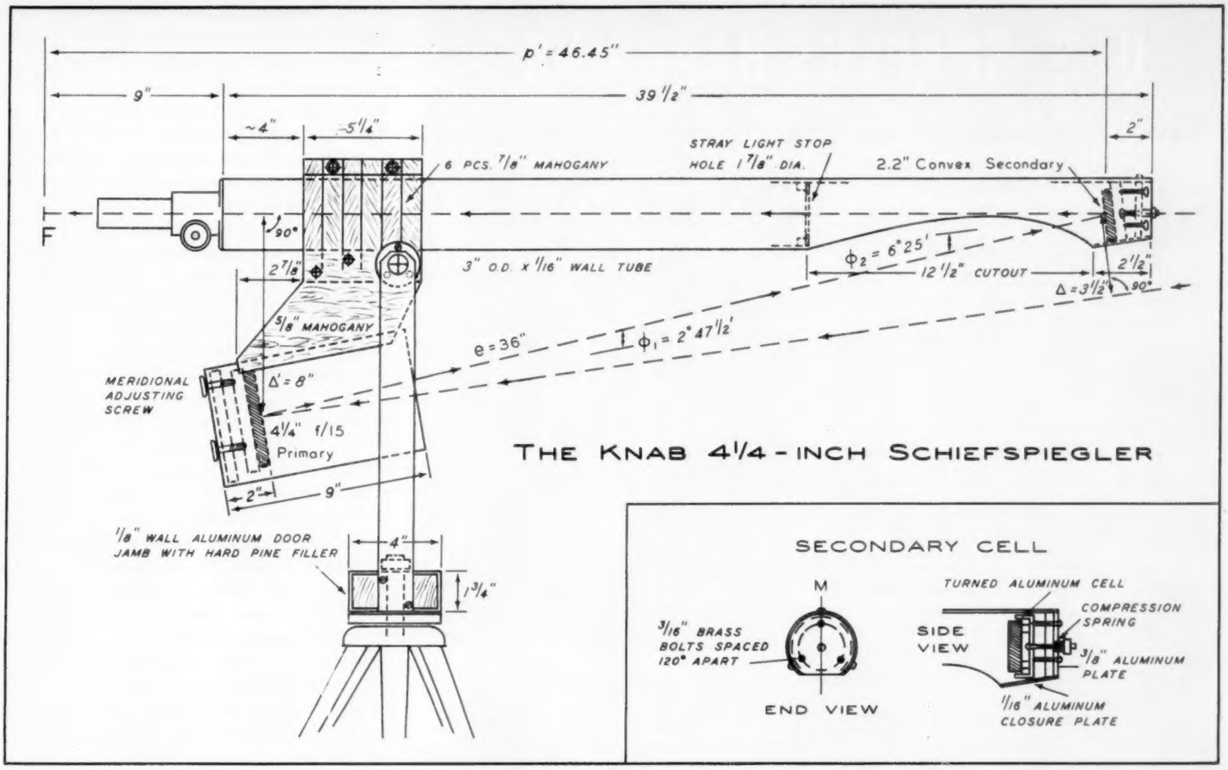
During all stages of grinding the primary, the curve was checked with a home-made spherometer employing a 0.0001" dial indicator, as described in SKY AND TELESCOPE for July, 1958, page 473. A spherometer is a boon for quick, accurate grinding, but after the completion of fine grinding the wetted primary was checked by the Foucault test. It is important to hold the radius of curvature to 1" tolerance if the indicated dimensions are to be used. Remember, too, that it is more difficult to achieve a good long-focus sphere than one of average focal ratio.

Polishing was done in the usual manner, except that another plate-glass disk was used for backing the pitch lap. Because of the very shallow curve required, this disk may be left flat if a good ¼" of pitch is poured on it. And after the primary was completed, the secondary, still 4¼ inches in diameter, was hot-pressed onto the same pitch lap, which quickly conformed to the shallow reverse curve.

During polishing, the convex surface

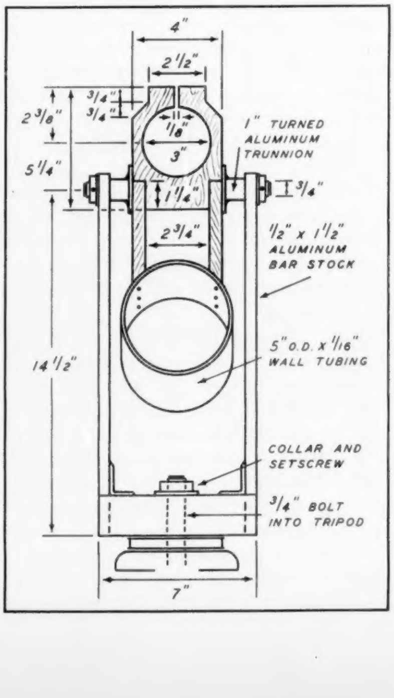


Oscar Knab's mahogany and jeweled-aluminum schiefspiegler (oblique reflector), on its alt-azimuth mounting. Optically, this type of telescope is particularly valuable for lunar and planetary observing, because of its excellent image quality. However, it is not suited for viewing dim extended objects, such as galaxies and nebulae, since the focal ratio is high. The field of view is remarkably flat, a great convenience for photographic work. Picture by the author.



Details of construction are given by Mr. Knab's diagram of his telescope and in the frontal view below, which is to the same scale. The dashed line indicates the path of the central ray of light entering the telescope, which is reflected by the mirrors at double the angles ϕ_1 and ϕ_2. Symbols in the drawing are identified in the table below.

was periodically tested through its flat back, using two thirds of the radius of curvature for the knife-edge position. This apparent shortening, as explained by Mr. Kutter in the April, 1959, SKY AND TELESCOPE, page 348, is due to refraction of the light cone as it passes through the glass. The surface could also have been checked by interference fringes if it were fitted against the concave primary.



The final biscuit cut was made through the secondary's finished surface, which was protected from grit by two layers of masking tape. Care was needed to assure alignment of this cut with the one coming from the back. But the secondary did not suffer from the carborundum used in cutting nor did it have a turned-down edge. It would have been difficult to achieve this result if the mirror had been ground after cutting it to size.

For the mounting, a full-sized layout should be scaled up from the drawing. The mahogany cradle was made at a mill;

SPECIFICATIONS

Symbolism according to Anton Kutter in *Bulletin A*

		Inches
D	Primary mirror aperture	4.25
d	Secondary mirror aperture	2.20
r	Mirrors' radius of curvature	127.50
f	Mirrors' focal length	63.75
F	Effective focal length	111.00
e	Separation of mirrors	36.00
p'	Secondary-to-focus distance	46.45
Δ	Secondary mirror offset from incoming optical axis	3.50
Δ'	Primary mirror offset from secondary-reflected axis	8.00
ϕ_1	Tilt of primary mirror to incoming optical axis	2° 47½'
ϕ_2	Tilt of secondary mirror to optical axis from primary	6° 25'

I bored out the 3" hole in the lathe, and made the ⅛" saw cut later. The ⅝" side pieces were left somewhat larger and were cut only after checking with the full-sized layout. A large piece of sandpaper was stretched over the curve of the primary tube and the side pieces were lapped to it after being screwed to the cradle. Six little wood screws inside the tube secure it to the side pieces. The distance Δ' between the center of the primary mirror and the optical axis of the secondary's reflection must be precisely 8". This is built into the mount, so it is very important to preserve it by fitting the side pieces and the tube together carefully.

After it is tilted into position, the secondary must be concentric with the 3" tube. I accomplished this by drilling the central hole in the back of the turned aluminum cell ⅛" below center. The ¼" bolt that fits this hole is swivel-mounted in the cell to afford the play necessary for tilt adjustment. A compression spring holds the cell firmly against three pointed adjusting screws that fit into small cup-shaped recesses in the back of the cell. These screws are threaded into tapped holes in the backing plates. In both primary and secondary cells, one of the adjusting screws must be in the mounting's meridional plane, as indicated by the **M** in the end view of the secondary cell.

The curved cutout in the secondary tube was done with a wire-bladed hacksaw and then filed smooth. The slanted cutoff at the mirror end of this tube was made with the end plate of the cell fastened in place, facilitating cutting by stiffening the end. The tubes were blackened inside with two coats of blackboard slating, and were machine-jeweled on the outside with steel wool wrapped around a rubber-capped wooden dowel in a drill press, and then lacquered. The mahogany received several coats of clear spar varnish.

For rough adjustment, place a tube with a ⅛" eye hole into the eyepiece holder, and tilt the secondary by means of the three adjusting screws until the primary cell shows concentrically in the secondary mirror. This need never be repeated. To set the primary, tape a 4¼" cardboard disk just under the secondary tube at its outer end, to indicate the direction of the rays that will enter the primary. Direct the primary until it looks squarely at this disk, and rough adjusting is completed.

Final aligning is done on a star in good seeing with a high-power eyepiece. If out-of-focus images are elliptical, adjust the meridional screw of the primary. If they are triangular close to focus, one of the mirrors is pinched too tightly in its cell. Residual coma of this instrument is 0.9 second of arc; and since the resolution is 1.06 seconds, the coma is invisible. Astigmatism is completely corrected by the tilt angles specified by Mr. Kutter.

This instrument is the largest that can

be made with the specifications given in the table, greater aperture requiring a corrector lens and other design changes. Images are crisp, sharp, and color free, with an unusually dark background, which results from the unobstructed light path to the primary mirror. With a 1-inch Erfle eyepiece, the moon is a magnificent sight.

The finished telescope weighs less than five pounds, but it is so powerful that it requires a very heavy, sturdy tripod. My war-surplus tripod weighs some 20 pounds. The fork could, of course, be equatorially mounted, shortening its blades somewhat. Slow motions can also be installed. If a finder is desired, it must be parallel to the primary tube, not the 3″ tube of the secondary.

According to reports that have reached me, the schiefspiegler is "finding its way." There are four of them in our area. H. Sherman of Minneapolis has completed a 6-inch and now has a 10-inch coma-free instrument with spherical corrector lens, clock drive, and other accessories, which he claims gives superb definition. My own 8-inch works perfectly since I changed from cylindrical lenses to a 4⅛″ spherical corrector that I made.

OSCAR R. KNAB
59237 S. Ironwood Rd.
South Bend 14, Ind.

NOTE: It should be pointed out that readers attempting to duplicate Anton Kutter's calculations for mirror tilts, as given in his *Bulletin A*, should not use the full size of the actual secondary, as this has been enlarged to give a fully illuminated focal plane. The correct figure for the secondary semidiameter is, therefore, 0.86″ rather than 1.1″.

By actual trial with a stopped-down f/12 5-inch mirror, I have verified the performance calculated for a 4-inch f/15 schiefspiegler. But when the system was tried at a 5-inch aperture, with the secondary impinging slightly on the primary, the image deteriorated badly. Thus, only by extending the focal length could this anastigmatic form of off-axis reflector be made larger than 4¼ inches. But the final focal ratio would be so large and the consequent light level so low as to be impractical.

At McDonnell Aircraft's optical department, we have considered using this form of instrument as a collimator, the flat field being ideal for placement of a reticle in the focal plane.

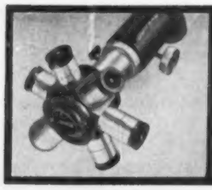
A few copies of *Bulletin A* are available from this department at 25 cents each. Mr. Kutter has offered to help serious amateurs if they have *special* problems. His address is Waldseer Strasse 3, Biberach an der Riss, West Germany.

R. E. C.

CORRECTIONS

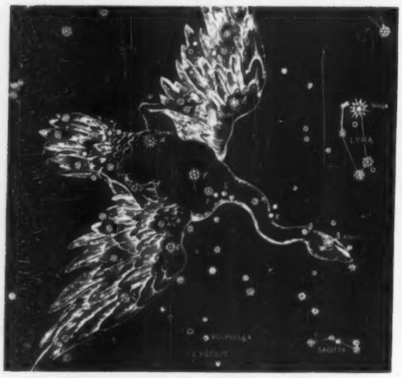
On page 114 of the August issue, in the ninth line of the article about OO Aquilae, the magnitude of this variable star at maximum should be 9.2 instead of 9.9.

In the caption for the left-hand picture of Comet Wilson on page 124, September issue, read "July 26th" for "June 26th."



UNITRON
MONTHLY REPORT TO OBSERVERS

SEE THE BACK COVER FOR MORE NEWS ABOUT *UNITRON*



constellation of the month
CYGNUS

Look in the western sky on a crisp October evening for the beautiful Northern Cross, standing nearly upright with the brilliant star Deneb at its top. This fine constellation is even better known as Cygnus, the Swan.

For UNITRON owners, Cygnus holds many wonders. Crossed by one of the richest parts of the Milky Way, it is more thickly strewn with stars than any other region of the northern skies. Choose an especially clear moonless night, and use a low-power, wide-field eyepiece on your UNITRON. To accustom your eyes to dim lights, spend 10 or 15 minutes in the dark before starting to observe. With these preparations, your tour of Cygnus will be long remembered.

As you rove over the constellation, the black field of the eyepiece seems sprinkled with the glitter of diamond dust, each grain a distant sun. While you slowly sweep in Cygnus, your telescope will show now a rich star cluster, now a dim milky wisp of nebulosity, or perhaps a ruby-red star. To the amateur who has seen all this, the words "glory of the heavens" have a special meaning.

Whether you observe in Cygnus for sheer pleasure or have some special purpose in mind, a UNITRON Refractor is your easiest access to the deep sky. Here the double star fan will find many pairs of every grade of difficulty. Easy to split in a 1.6-inch UNITRON is Beta Cygni (the foot of the Cross), a golden 3rd-magnitude star with a bluish 5th-magnitude companion about 35 seconds of arc distant.

A good star atlas such as Norton's will help in locating many other doubles. For example, 16 Cygni and 61 Cygni are both wide pairs, pretty sights in a small UNITRON. At the other extreme of difficulty, Lambda in this constellation is a challenge for a skillful observer with a 6-inch, being of magnitudes 5 and 6, with a separation of only 0.8 second. Delta Cygni is a 2-second pair, hard to resolve because of the very different magnitudes of its components, 3 and 6½.

Two open star clusters of the famous Messier list lie inside Cygnus, M29 and M39, the latter being a specially worth-while sight. Also, use the view finder of your UNITRON to inspect the very large and scattered grouping of bright stars around Gamma Cygni.

MANY Models To Choose From!

- **2" SATELLITE ($7.50 Down)** 6x, diagonal eyepiece, altazimuth mount with circles, stand — **$75**
- **1.6" ALTAZIMUTH ($7.50 Down)** with eyepieces for 78x, 56x, 39x — **$75**
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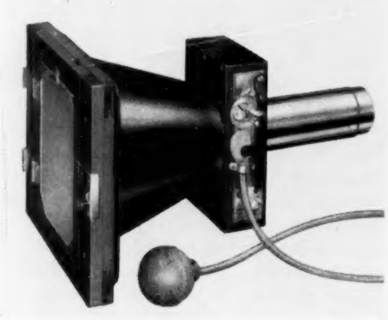
- **2.4" EQUATORIAL ($22.50 Down)** with eyepieces for 129x, 100x, 72x, 50x, 35x — **$225**
- **3" ALTAZIMUTH ($26.50 Down)** with eyepieces for 171x, 131x, 96x, 67x, 48x — **$265**
- **3" EQUATORIAL ($43.50 Down)** with eyepieces for 200x, 131x, 96x, 67x, 48x — **$435**
- **3" PHOTO-EQUATORIAL ($55.00 Down)** with eyepieces for 200x, 171x, 131x, 96x, 67x, 48x — **$550**
- **4" ALTAZIMUTH ($46.50 Down)** with eyepieces for 250x, 214x, 167x, 120x, 83x, 60x — **$465**
- **4" EQUATORIAL ($78.50 Down)** with eyepieces for 250x, 214x, 167x, 120x, 83x, 60x, 38x — **$785**
- **4" EQUATORIAL** with clock drive **($98.50 Down)**, Model 160V, eyepieces as above — **$985**
- **4" PHOTO-EQUATORIAL** with clock drive and Astro-camera **($117.50 Down)**, eyepieces for 250x, 214x, 167x, 120x, 83x, 60x, 38x, 25x — **$1175**
- **4" PHOTO-EQUATORIAL** with clock drive, pier, Astro-camera **($128.00 Down)**, eyepieces for 375x, 300x, 250x, 214x, 167x, 120x, 83x, 60x, 38x, 25x — **$1280**
- **6" EQUATORIAL** with clock drive, pier, 2.4" view finder, eyepieces for 625x, 500x, 416x, 357x, 277x, 200x, 138x, 100x, 62x, 42x — **$5125**

CALLING ALL UNITRON OWNERS!

If you purchased a UNITRON before the Achromatic Amplifier was available, we want you to have the chance to get one, and offer it at the special price of $6.00 — less than one third the price you'd pay elsewhere for an accessory of this quality. This offer is for UNITRON owners only. (When ordering, please state whether for UNIHEX or star diagonal.)



UNITRON accessory of the month
ASTRO-CAMERA

The UNITRON Astro-Camera 220 is a lightweight camera designed especially for photography using the objective lens (or mirror) of the telescope as the principal optical element. The camera may be positioned so that a picture is taken of the image at the primary focus. Alternately an eyepiece may be inserted in the camera tube and placed so as to project a magnified image on the film plane. An air-operated curtain shutter of the Thornton-Pickard type gives speeds from 1/10 to 1/90 second, in addition to bulb and time. Three double plateholders are included for 3¼" x 4¼" plates or cut film. These are designed so that the film slide does not detach from the film holder itself when making an exposure; thus manipulation is easy in the dark. The camera comes complete with ground-glass focusing back, extension tubes, special 30-mm.-f.l. photo-ocular, eyepiece holder, filter, clamps, air-operated shutter release, cabinet, and instructions, at a cost of $69.50. An ideal accessory for UNITRONS and other telescopes as well.

New UNITRON View Finders

UNITRON's popular view finders with newly designed optics and mechanical features are better than ever. From left to right: 23.5 mm., 30 mm., 42 mm.

1. VIEW FINDER (Used on UNITRON 2.4" Equatorials): 23.5-mm. (.93") achromatic objective, 6x eyepiece with crosshairs. Chromed brass tube. Mounting brackets with centering screws.

Only $8.50 postpaid

2. VIEW FINDER (As used on UNITRON 3" Refractors): 30-mm. (1.2") coated achromatic objective and 8x eyepiece with crosshairs. Other details as in View Finder 3.

Only $10.75 postpaid

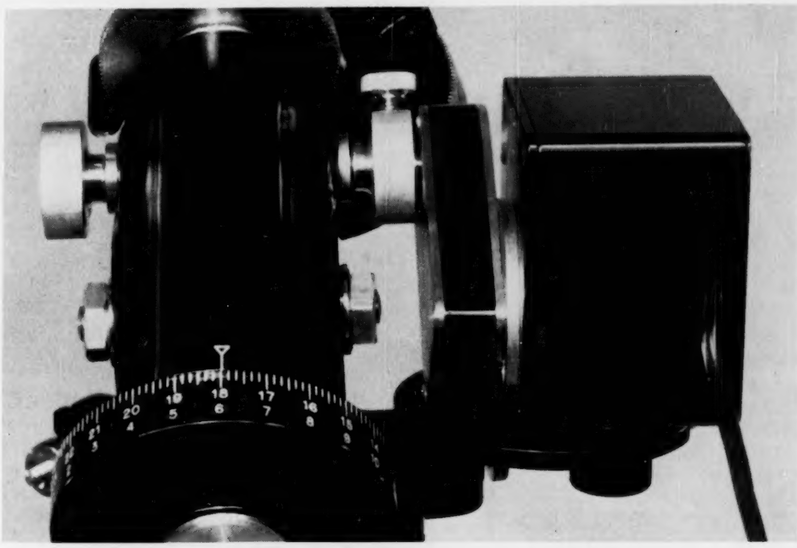
3. VIEW FINDER (As used on UNITRON 4" Refractors): 42-mm. (1.6") coated achromatic air-spaced objective. 10x eyepiece with crosshairs. Duralumin tube finished in white enamel. Dewcap. Furnished with mounting brackets, centering screws for collimation, and mounting screws. This finder measures approximately 16" overall. It is light in weight, compact and small enough for use as a hand telescope furnishing spectacular wide-field views of the sky.

Only $18.00 postpaid

Announcing . . . the New UNITRON CLOCK DRIVES

Here is news of the greatest interest both to prospective owners and those who already have a UNITRON Refractor. Synchronous motor clock drives for all UNITRON equatorial models are now in the process of completion and will be available for sale in about 30 days. With one of these drives to track celestial objects for you, observing with your UNITRON will be more convenient than ever.

UNITRON Synchronous Clock Drives are the product of careful planning and design to achieve certain definite goals that you, the observer, have requested. You wanted a drive that could be readily added to the many UNITRON equatorial models already in use, without need for factory installation or expensive adaptation. Since most UNITRON models use a field tripod, the drive had to be sufficiently compact so as not to interfere in any way with portability. Emphasis was placed on designing a method of coupling that would maintain perfect stability of the tube during focusing or when attaching or removing accessories. It hardly need be mentioned that you insisted on a vibration-free drive that would operate with the accuracy of a sidereal clock. Lastly, you told us it was important that the drive be priced for even limited budgets.



The new UNITRON drives meet all of these requirements in every way. The rugged synchronous motor is mounted in an attractive metal housing to which is attached a compact reduction-gear assembly. A thumbscrew locks the housing to a small shelf which,

The motor with gear box and shelf.

in turn, clamps to the base of the equatorial mount, above the tripod head. The output shaft of the gear system connects directly to the right ascension hand drive knob. This method of coupling, using as it does the regular worm gear mechanism of the telescope, insures stability of the tube and eliminates the "play" that is often found in drives that connect directly to the polar axis. It takes but a minute to attach the drive, or to remove it for terrestrial observation or when on field trips away from a 110-volt outlet.

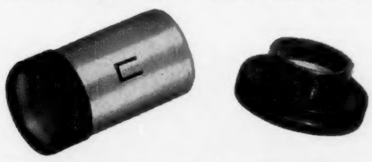
Our own private oracle has just informed us that most present owners of UNITRON equatorial models will want to add the motor drive to their telescopes. Here, again, our unique method of mounting makes it possible to install the drive by merely turning a few thumbscrews. Recent UNITRON equatorials have a right ascension knob that has been drilled to accept the flexible cable slow-motion control now being supplied as standard equipment. This same hole is used as the connector to the shaft of the gear box on the new motor drive. For earlier models, a replacement control knob of the newer type will be supplied with the drive at no additional charge.

Observers will be pleased to learn that a precision mechanism of this type is remarkably low in price: only $50.00 for the 2.4-inch model and only $60.00 for the 3-inch model, shipping charges included. The cost of the motor drive for the 4-inch unit will be announced later. With reference to the 4-inch, most readers already know about the UNITRON Models 160 and 166, which are equipped with a weight-driven clock drive mechanism. These will continue to remain popular because the weight drive is completely independent of a source of electricity.

Orders are now being accepted for the 2.4-inch and 3-inch drives, and shipment will be made on a first-come, first-served basis. A letter from you is all that is needed to reserve one of these units for earliest delivery, and payment need not be made until the drive is ready for shipment. To order a complete UNITRON Refractor with a clock drive, specify Model 128C for the 2.4-inch Equatorial Refractor with motor drive at $275.00, and Model 142C for the 3-inch Equatorial Refractor with motor drive at $495.00. If the motor drive is not ready at the time we receive your order, shipment of the telescope will be made at once and of the drive shortly thereafter.

Even if you have misplaced your Julian Day Calendar, you are certain to realize that Christmas is not too far away. What better gift can there be for a UNITRON owner than one of the new motor drives . . . and what better gift for the non-UNITRON owner than a *motorized* UNITRON?

NEW ACHROMATIC AMPLIFIER NOW FREE with each UNITRON



UNITRON's new "Achromatic Amplifier" is a two-element, Barlow-type, negative amplifying lens designed especially for UNITRON Refractors. When used with a UNITRON eyepiece, it **doubles** the normal magnification of the telescope. Here is an ideal way to increase the usefulness of each eyepiece and to obtain the high magnifications that you have always wanted for planetary and lunar observations. The magnification factor of 2x has been selected as the most useful for general amateur observing under a wide variety of atmospheric conditions. Two types of mounting cells are offered: one to fit the UNIHEX Rotary Eyepiece Selector and one for the UNITRON Star Diagonal. Either type can be inserted or removed in a jiffy. There are no cumbersome tubes to attach, nor ever any need to adjust the focus of the "Achromatic Amplifier."

This useful and valuable accessory is now included as standard equipment with all UNITRON Refractors at no additional cost . . . another of the many reasons why the telescope you choose should be a UNITRON.

HOW TO ORDER A UNITRON

Send check or money order in full or use our Easy Payment Plan. Shipments made express collect. Send 20% deposit for C.O.D. shipment. UNITRON instruments are fully guaranteed for quality, workmanship, and performance, and must meet with your approval or your money back. Prices of UNITRON refractors include basic accessories, eyepieces, tripod and mounting, fitted cabinets, and instructions.

USE OUR EASY PAYMENT PLAN

UNITRON's popular Easy Payment Plan is a convenient and economical way to buy your UNITRON Refractor. The down payment required is 10%. The balance due is payable over a 12-month period, and there is a 6% carrying charge on the unpaid balance. Your first payment is not due until 30 days after you receive the instrument, and if you should want to pay the entire balance due at that time, the carrying charge is cancelled.

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- Glossary of telescope terms
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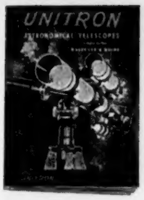

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NAME ______________________

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CELESTIAL CALENDAR

Universal time (UT) is used unless otherwise noted.

MINOR PLANET PREDICTIONS

Irene, 14, 10.4. October 18, 3:19.0 +8-17; 28, 3:11.0 +7-49. November 7, 3:01.7 +7-24; 17, 2:52.0 +7-06; 27, 2:43.0 +6-58. December 7, 2:35.7 +7-02. Opposition on November 9th.

Ceres, 1, 7.0. October 18, 3:39.0 +10-00; 28, 3:31.9 +9-46. November 7, 3:23.2 +9-33; 17, 3:13.7 +9-26; 27, 3:04.4 +9-27. December 7, 2:56.5 +9-38. Opposition on November 14th.

Kalliope, 22, 10.1. October 18, 3:40.7 +11-17; 28, 3:33.5 +11-27. November 7, 3:24.4 +11-38; 17, 3:14.6 +11-54; 27, 3:05.1 +12-16. December 7, 2:56.9 +12-45. Opposition on November 14th.

Vesta, 4, 6.8. October 28, 4:05.3 +11-49. November 7, 3:56.5 +11-25; 17, 3:46.4 +11-05; 27, 3:35.8 +10-51. December 7, 3:26.2 +10-48; 17, 3:18.6 +10-57. Opposition on November 20th.

After the asteroid's name are its number and the approximate visual magnitude expected at opposition. At 10-day intervals are given its right ascension and declination (1950.0) for 0^h Universal time. In each case the motion of the asteroid is retrograde. Data are supplied by the IAU Minor Planet Center at the University of Cincinnati Observatory.

OCTOBER METEORS

The waxing gibbous moon will interfere with observations of the Orionid meteors as they reach maximum numbers on October 20th this year. Early stages of the eight-day shower, however, should be favorable. Under the best conditions an observer would be able to see up to 25 meteors per hour during maximum. The radiant lies about 10° northeast of Betelgeuse.

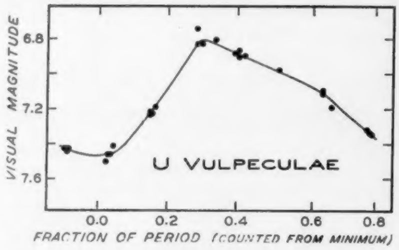
WILLIAM H. GLENN

U VULPECULAE

A 7 x 50 monocular is a very convenient instrument for observing variable stars too faint for the unaided eye yet too bright for a small mounted refractor or reflector. It will serve well for such a star as U Vulpeculae, one of the less familiar bright Cepheids. This variable is situated at right ascension 19^h $34^m.4$, declination +20° 13′ (1950 co-ordinates) – just north of the Vulpecula-Sagitta boundary – and is labeled in both Norton's *Star Atlas* and the Skalnate Pleso *Atlas of the Heavens*. The range in visual magnitude is from 6.8 to 7.5.

Discovery of the light changes of U Vulpeculae came in 1897, when the Potsdam astronomers G. Müller and P. Kempf noted discordances in their measurements of its brightness, during compilation of their great photometric catalogue of all northern stars brighter than magnitude 7.5. Quite a number of well-known variables were discovered by them in this way, among them W Ursae Majoris, RZ and SU Cassiopeiae, and X Persei.

Soon afterwards, U Vulpeculae was recognized to be a Cepheid variable with a period of almost exactly eight days; the current Moscow *General Catalogue of Variable Stars* cites 7.990676 days. As a result, observations made during one season at the same observing station will give only eight short stretches of the light curve, separated by "daytime gaps."



This recent photoelectric light curve of the Cepheid variable star U Vulpeculae is from measurements in yellow light. The dots represent individual observations. Adapted from "Bulletin" No. 110 of Lowell Observatory.

This effect is noticeable in the accompanying plot of photoelectric observations obtained by H. Weaver and his coworkers at Lowell Observatory during the summer of 1959.

As this curve shows, the rise in brightness from minimum to maximum takes only about 3/10 of the period – typical behavior for a Cepheid. The shape of the light curve seems normal, with an indication of the hump on the descending branch that is usual in other Cepheids with periods of seven or eight days, such as Eta Aquilae.

VARIABLE STAR MAXIMA

October 9, W Lyrae, 181136, 7.9; 17, V Bootis, 142539, 7.9; 17, RV Sagittarii, **182133**, 7.8; 20, R Phoenicis, **235150**, 8.0; 22, R Lyncis, 065355, 7.9; 25, R Bootis, 143227, 7.2; 27, S Hydrae, 084803, 7.8; 28, X Centauri, **114441**, 8.0; 28, V Canum Venaticorum, 131546, 6.8.

November 6, T Normae, **153654**, 7.4.

These predictions of variable star maxima are by the AAVSO. Stars are listed only if brighter than magnitude 8.0 at an average maximum. Some, but not all of them, are nearly as bright as maximum two or three weeks before and after the date given. The data include, in order, the day of the month near which the maximum should occur, the star name, the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern), and the predicted visual magnitude.

MINIMA OF ALGOL

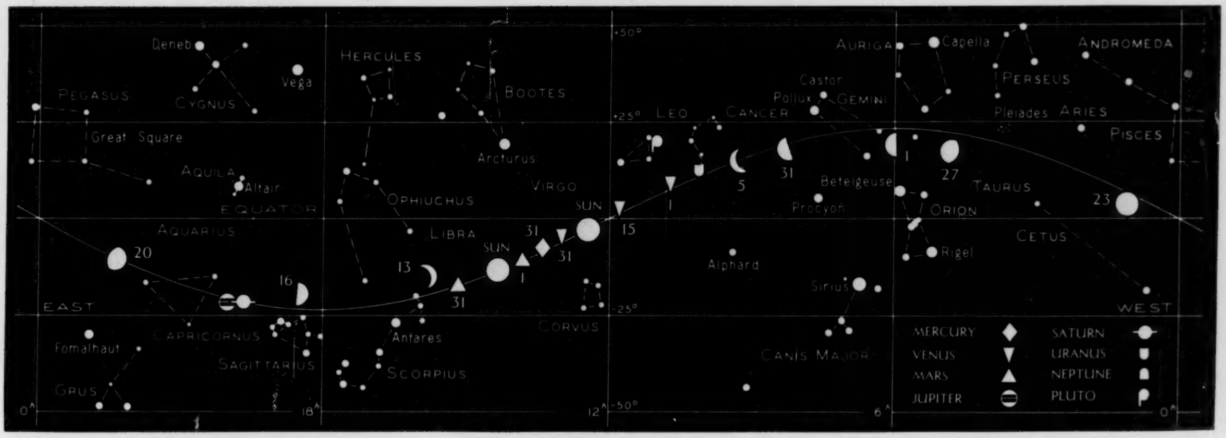
October 3, 5:54; 6, 2:43; 8, 23:32; 11, 20:20; 14, 17:09; 17, 13:58; 20, 10:47; 23, 7:36; 26, 4:25; 29, 1:14; 31, 22:03.

November 3, 18:52; 6, 15:41; 8, 12:30.

These minima predictions for Algol are based on a recent timing by D. Engelkemeir and an assumed period of 2.8674 days. The times given are geocentric; they can be compared directly with observed times of least brightness.

UNIVERSAL TIME (UT)

In the Celestial Calendar, Universal time (Greenwich civil time) is used unless otherwise specified. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. To obtain daylight saving time subtract 4, 5, 6, or 7 hours respectively. If necessary, add 24 hours to the UT before subtracting, in which case the result is your standard time on the day preceding the Greenwich date shown. For example, 6:15 UT on the 15th of the month corresponds to 1:15 a.m. EST on the 15th and to 10:15 p.m. PST on the 14th.



THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month or for other dates shown. All positions are for 0^h Universal time on the respective dates.

Mercury will be stationary in right ascension twice in October, beginning its retrograde (westward) motion among the stars on the 11th and ending it October 31st. On the latter date the planet, of the 1st magnitude, rises about $1\frac{1}{4}$ hours before the sun, and will be visible low in the east. But most of the month Mercury will be too close to the sun to be seen, as it passes from the evening to the morning sky, with inferior conjunction on October 22nd.

Venus, brilliant at magnitude -3.4, rises about two hours before the sun on the 15th. The planet then shows a small telescopic disk, 11″ in diameter and 90-per-cent illuminated. As seen from Europe, the waning crescent moon will occult Venus early on October 7th; that morning the two objects will form a striking pair for watchers in the eastern United States.

Mars is an evening object too close to the sun to be seen in October.

Jupiter reaches eastern quadrature on the 22nd, then at magnitude -1.9, crossing the meridian shortly after sunset and setting about an hour before local midnight. It is near the Capricornus-Sagittarius border, about 5° east of Saturn. On the 22nd, Jupiter's telescopic disk has an equatorial diameter of 39″.6 and a polar one of 36″.9.

Saturn, at eastern quadrature on the 17th, is near the meridian at sunset, remaining visible in the southwestern sky during the early evening hours, an object of magnitude $+0.7$. On that date, the planet's equatorial and polar diameters are 16″.8 and 15″.0, respectively, and the ring system has a major axis of 37″.7. The moon will pass about 3° north of Saturn at 5^h UT on October 17th.

Uranus will be easy to locate with binoculars in the morning sky this month during its close approach to 1st-magnitude Regulus. The 6th-magnitude planet is moving slowly southeast, on the morning of October 7th being 24′ north-northwest of Regulus, and on the 11th 17′ due north. Closest approach comes on the 13th, the separation being 15′. By October 16th, Uranus will be 16′ northeast of the star, and two mornings later they will be 19′ apart. During the week before and after closest approach, Uranus can be easily identified, as there are no neighboring stars of similar brightness to be mistaken for it.

Neptune, close to Mars in the sky, is too near the sun all month to be visible.

WILLIAM H. GLENN

MOON PHASES AND DISTANCES

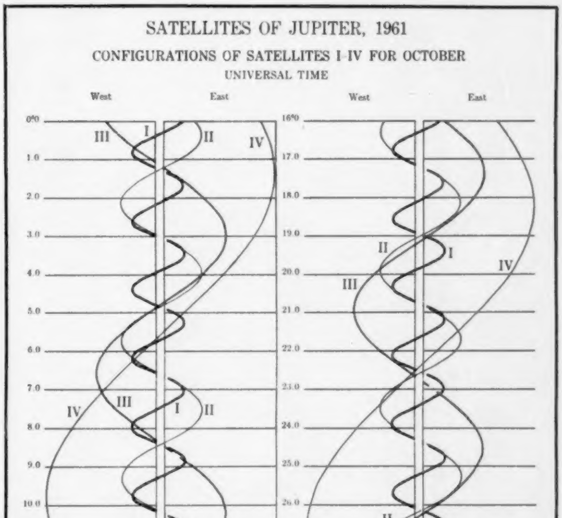
Last quarter	October	1, 14:10
New moon	October	9, 18:53
First quarter	October	17, 4:35
Full moon	October	23, 21:31
Last quarter	October	31, 8:59
New moon	November	8, 9:59

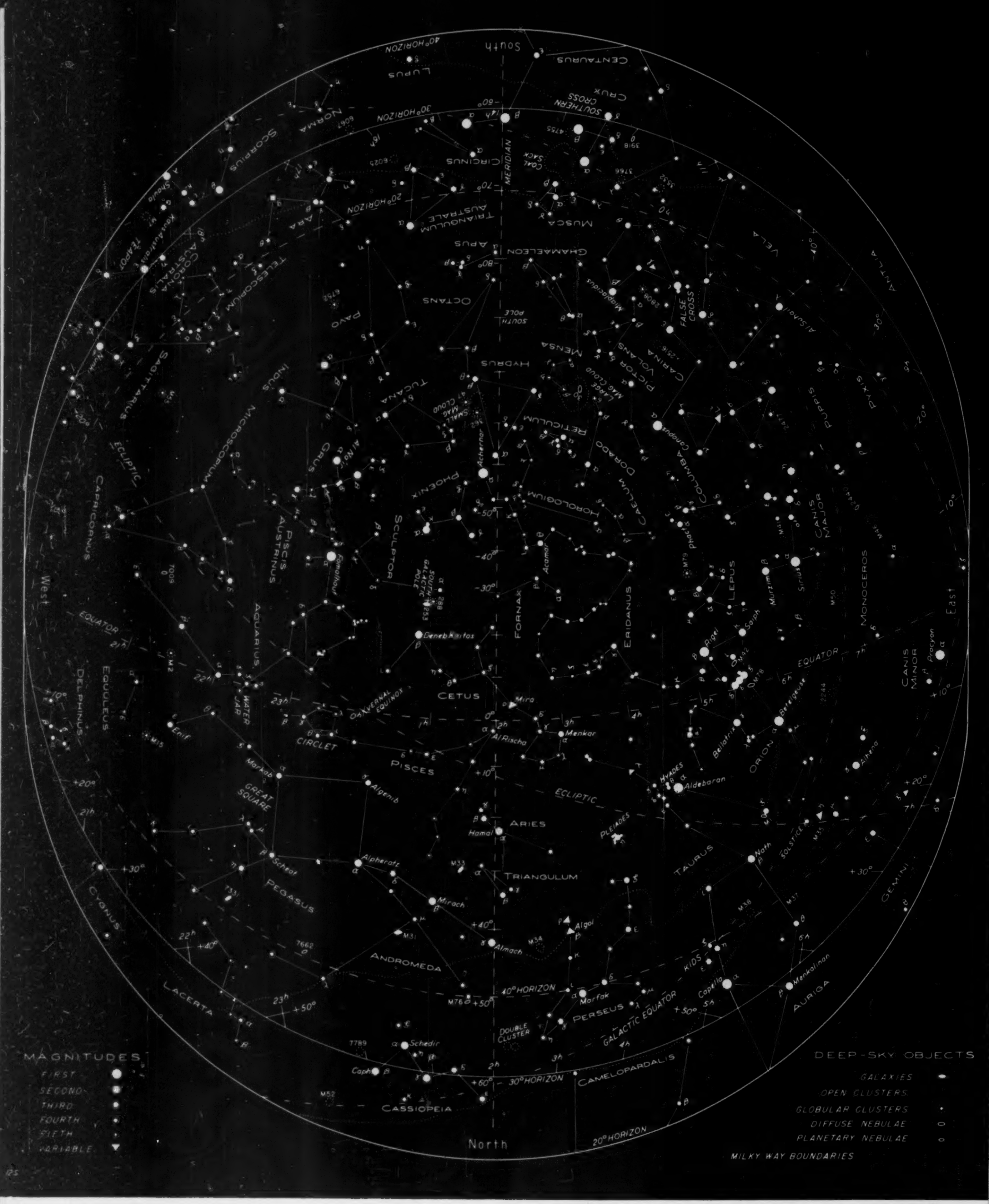
October	Distance	Diameter
Apogee 5, 8^h	251,900 mi.	29′ 29″
Perigee 21, 7^h	226,500 mi.	32′ 47″
November		
Apogee 2, 2^h	251,400 mi.	29′ 32″

JUPITER'S SATELLITES

The four curving lines represent Jupiter's four bright (Galilean) satellites: I, Io; II, Europa; III, Ganymede; IV, Callisto. The location of the planet's disk is indicated by the pairs of vertical lines. When a satellite passes in front of Jupiter, its curve crosses the lines. If a moon is invisible because it is occulted by Jupiter or is in the planet's shadow, the curve is broken.

For successive dates, the horizontal lines mark 0^h Universal time, or 7 p.m. Eastern standard time (4 p.m. Pacific standard time) on the preceding day. Along the vertical scale, 1/16 inch is about seven hours. In this chart, west is to the left, as in an inverting telescope for a Northern Hemisphere observer. At the bottom, "d" is the point of disappearance of a satellite in Jupiter's shadow; "r" is the point of reappearance. From the "American Ephemeris and Nautical Almanac."

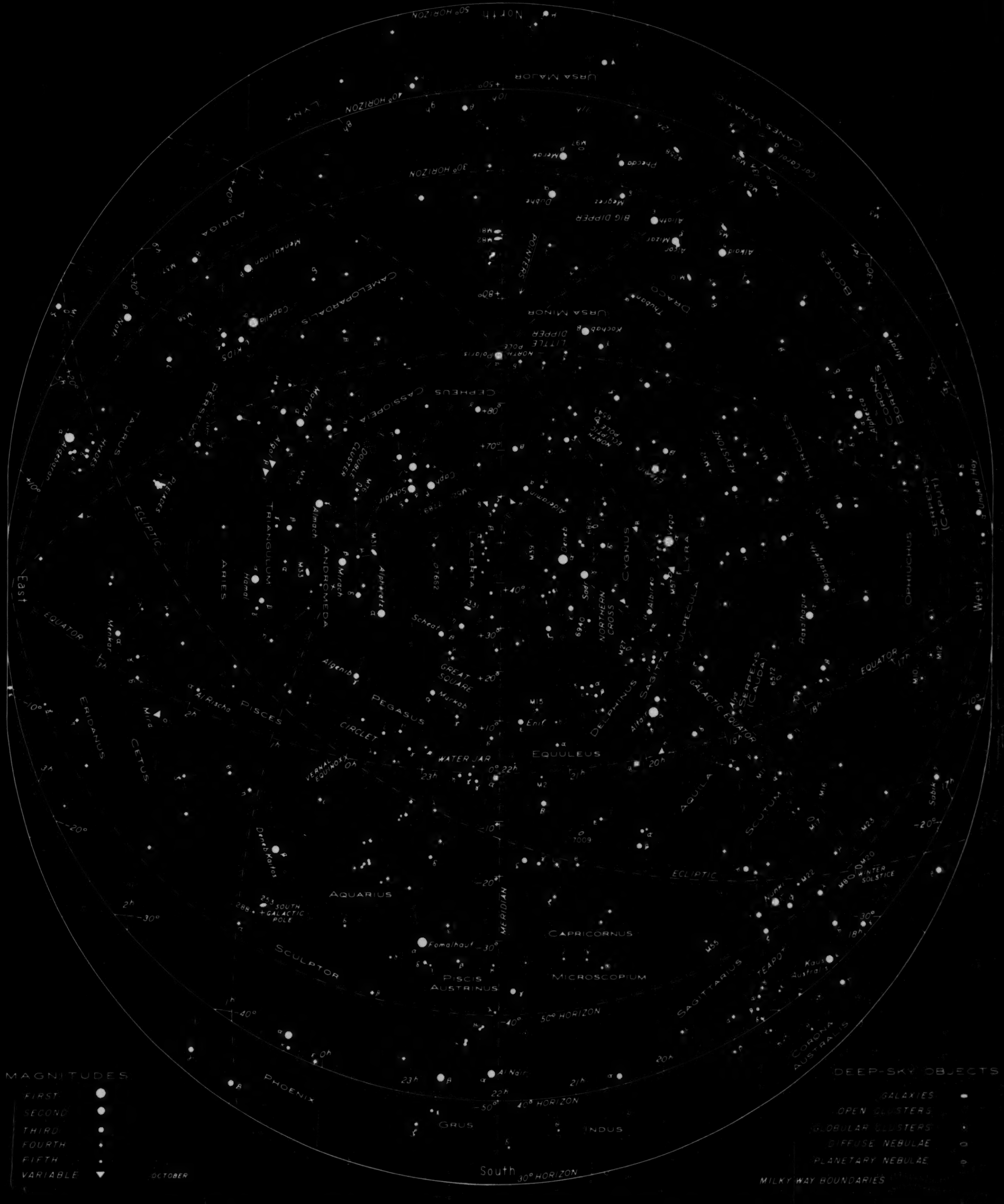




SOUTHERN STARS

The sky as seen from latitudes 20° to 40° south, at 11 p.m. and 10 p.m., local time, on the 6th and 21st of November, respectively; also, at 9 p.m. and 8 p.m. on December 6th and 22nd. For other dates, add or subtract ½ hour per week.

Well up in the southeast is Dorado, marked by the Large Magellanic Cloud. Beta Doradus is the brightest Cepheid variable star in the southern sky. It is yellow, with a 10-day period. Its light changes were discovered by Harlow Shapley almost 40 years ago.



STARS FOR OCTOBER

The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 22nd of October, respectively; also, at 7 p.m. and 6 p.m. on November 6th and 21st. For other dates, add or subtract ½ hour per week.

On the southern horizon at chart time, west and south of Fomalhaut, is Grus the Crane, the Egyptian symbol of a star observer because of the bird's high flight. B. A. Gould in South America catalogued 107 stars in this constellation as being visible to the naked eye.

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